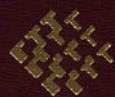


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Handbook of Thermodynamic Diagrams



Volume 1

Organic
Compounds
 C_1 to C_4

Carl L. Yaws

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Handbook of Thermodynamic Diagrams



Volume 1

Organic
Compounds
C₁ to C₄

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Handbook of Thermodynamic Diagrams



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CONTRIBUTORS

Mei Han	Graduate student, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.
Sachin D. Sheth	Graduate Student, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.
Carl L. Yaws	Professor, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.

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DISCLAIMER

This handbook presents a variety of thermodynamic and physical property data. It is incumbent upon the user to exercise judgment in the use of the data. The author and publisher do not provide any guarantee, express or implied, with regard to the general or specific applicability of the data, the range of errors that may be associated with any of the data, or the appropriateness of using any of the data in any subsequent calculation, design, or decision process. The author and publisher accept no responsibility for damages, if any, suffered by any reader or user of this handbook as a result of decisions made or actions taken on information contained herein.

PREFACE

Thermodynamic property data are important in many engineering applications in the chemical processing and petroleum refining industries. The objective of this book is to provide the engineer with such data. The data are presented in thermodynamic diagrams (graphs) covering a wide range of pressures and temperatures to enable the engineer to quickly determine values at points of interest. The contents of the book are arranged in the following order: graphs, references, and appendixes.

The graphs are arranged by carbon number and chemical formula to provide ease of use. English units are used for the property values. For those involved in SI and metric usage, each graph displays a conversion factor to provide the SI and metric units.

The graphs provide wide coverage for volume and enthalpy as a function of temperature and pressure, including the following:

- two-phase region for saturated liquid and vapor
- superheated gas region for gases above saturation temperature
- subcooled liquid region for liquids below saturation temperature
- supercritical region for temperatures and pressures above critical point

The graphs for enthalpy also contain lines of constant entropy to permit engineering usage for 2nd law problems such as adiabatic expansion and compression of fluids.

The coverage encompasses a wide range of organic compounds including hydrocarbons, such as alkanes, olefins, acetylenes, and cycloalkanes; oxygenates, such as alcohols, aldehydes, ketones, acids, ethers, glycols, and anhydrides; halogenates, such as chlorinated, brominated, fluorinated, and iodinated compounds; nitrogenates, such as nitriles, amines, cyanates, and amides; sulfur compounds, such as mercaptans, sulfides, and sulfates; silicon compounds, such as silanes and chlorosilanes; and many other chemical types.

The range of coverage for pressure is from 10 to 10,000 psia. Very limited experimental data are available at pressures above 1,000 to 2,000 psia. Thus, values at the higher pressures should be considered rough approximations. Values at lower pressures are more accurate.

The graphs are based on the Peng-Robinson equation of state (1) as improved by Stryjek and Vera (2, 3). The equations for thermodynamic properties using the Peng-Robinson equation of state are given in the appendix for volume, compressibility factor, fugacity coefficient, residual enthalpy, and residual entropy. Critical constants and ideal gas heat capacities for use in the equations are from the data compilations of DIPPR (8) and Yaws (28, 29, 30).

The literature has been carefully searched in construction of the graphs. References for sources used in preparing the work are given in the section following the graphs near the end of the book.

For the graphs, some of the compounds may undergo thermal decomposition (reaction) at the higher temperatures. For such cases of thermal decomposition, the graphs are useful for ascertaining property values of the pure compound which is contained in the reaction mixture. Chemistry handbooks and DIPPR (8) notes may be used for specifics regarding thermal decomposition.

A list of compounds is given near the end of the book to aid the user in quickly locating compounds of interest from knowledge of the chemical formula or name.

An executable computer program, complete with data files, is available for calculation of thermodynamic properties. For information on the program, contact Carl L. Yaws, Ph.D., P. O. Box 10053, Beaumont, Texas 77710, phone/fax (409) 880-8787.

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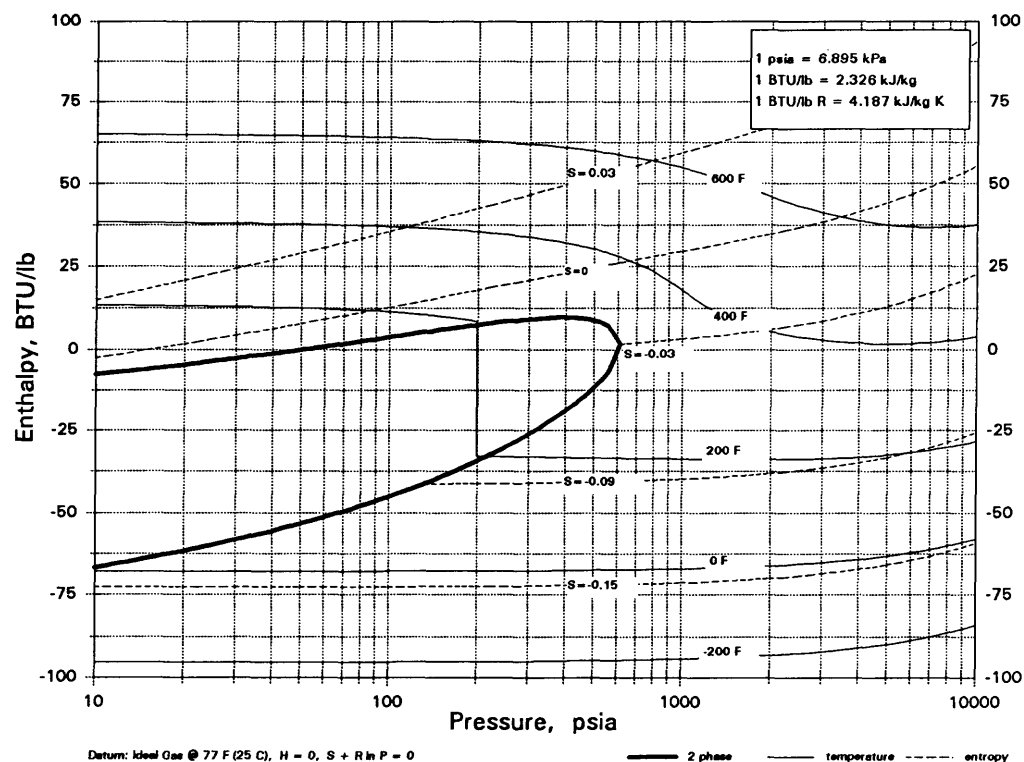
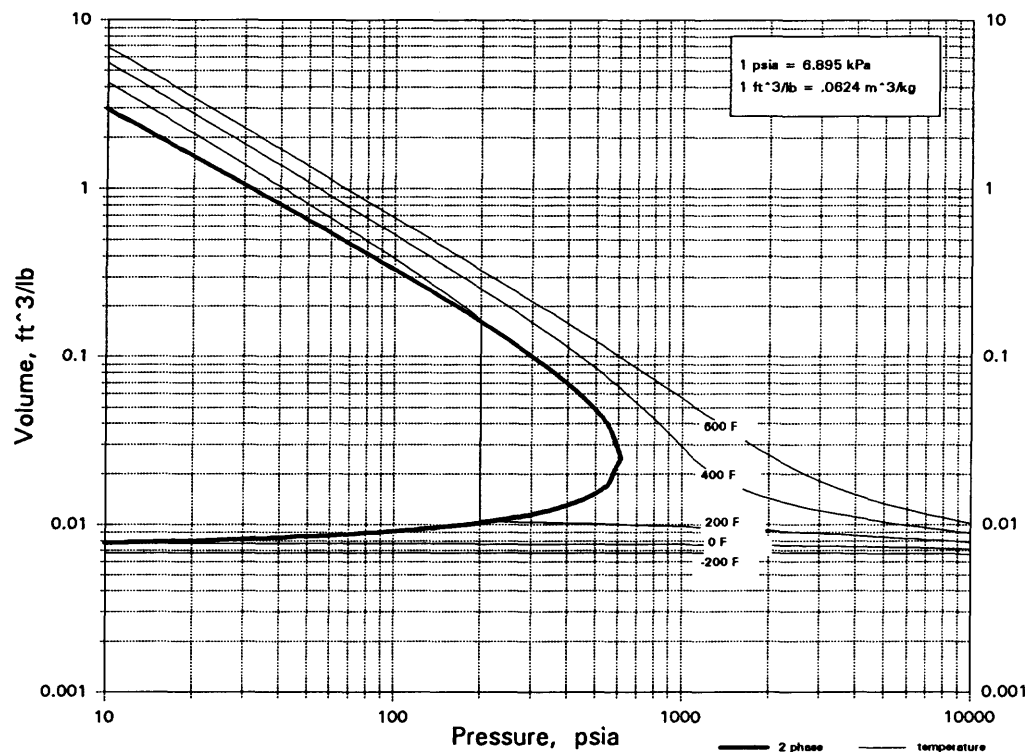
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Organic
Compounds
C₁ to C₄

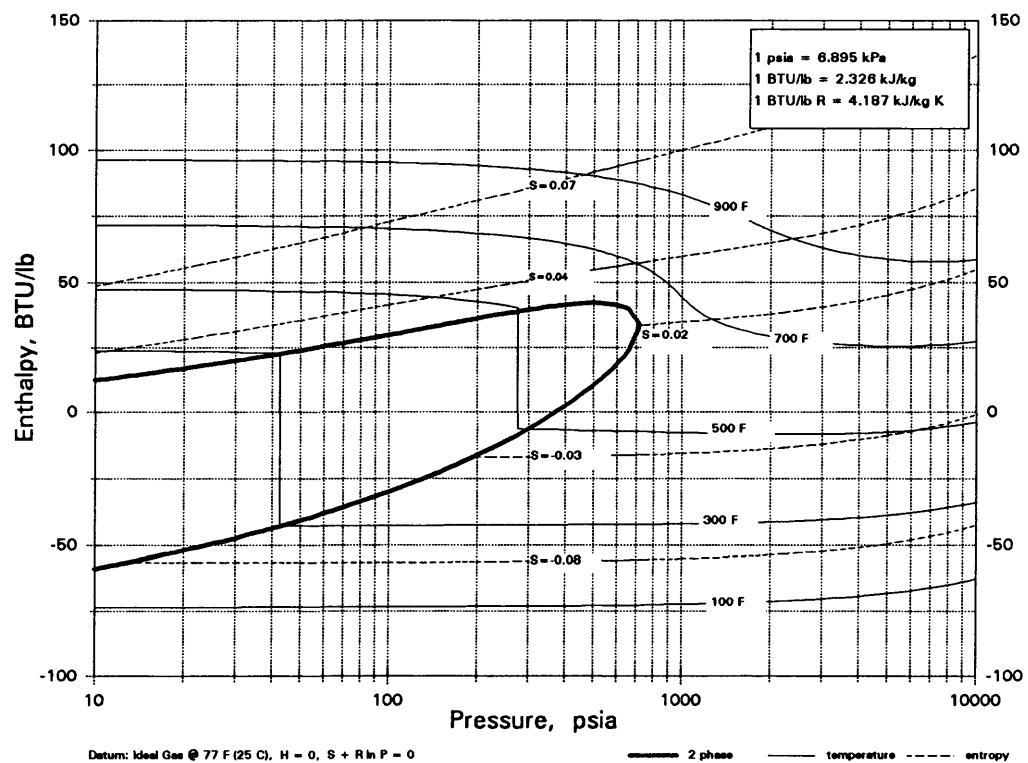
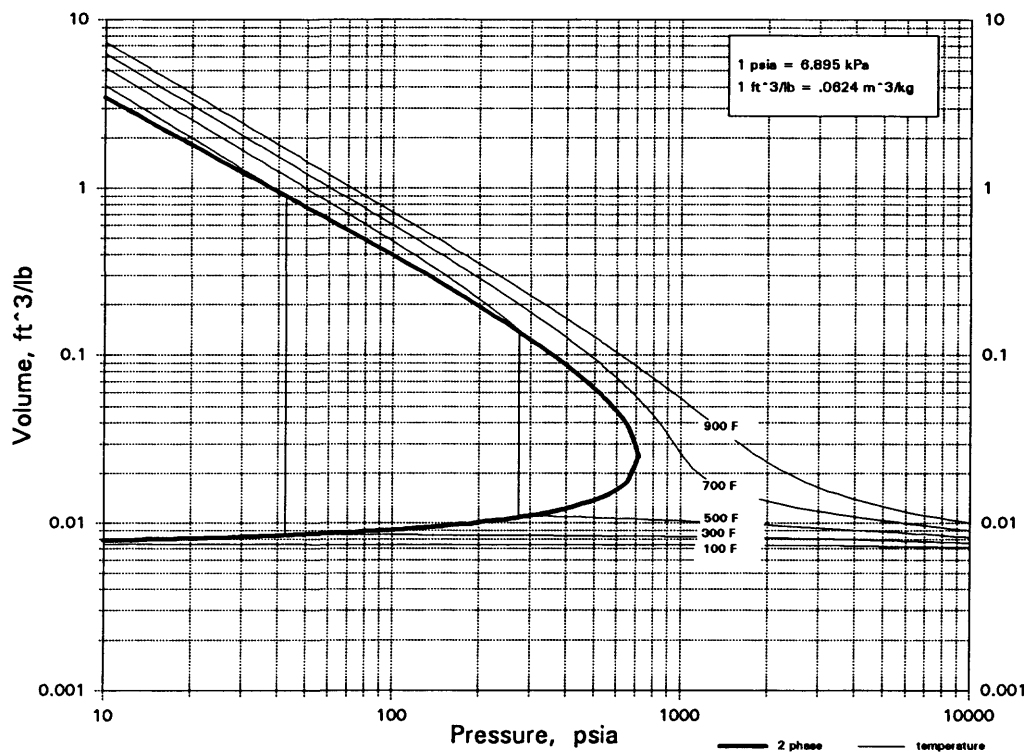
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CBrClF₂

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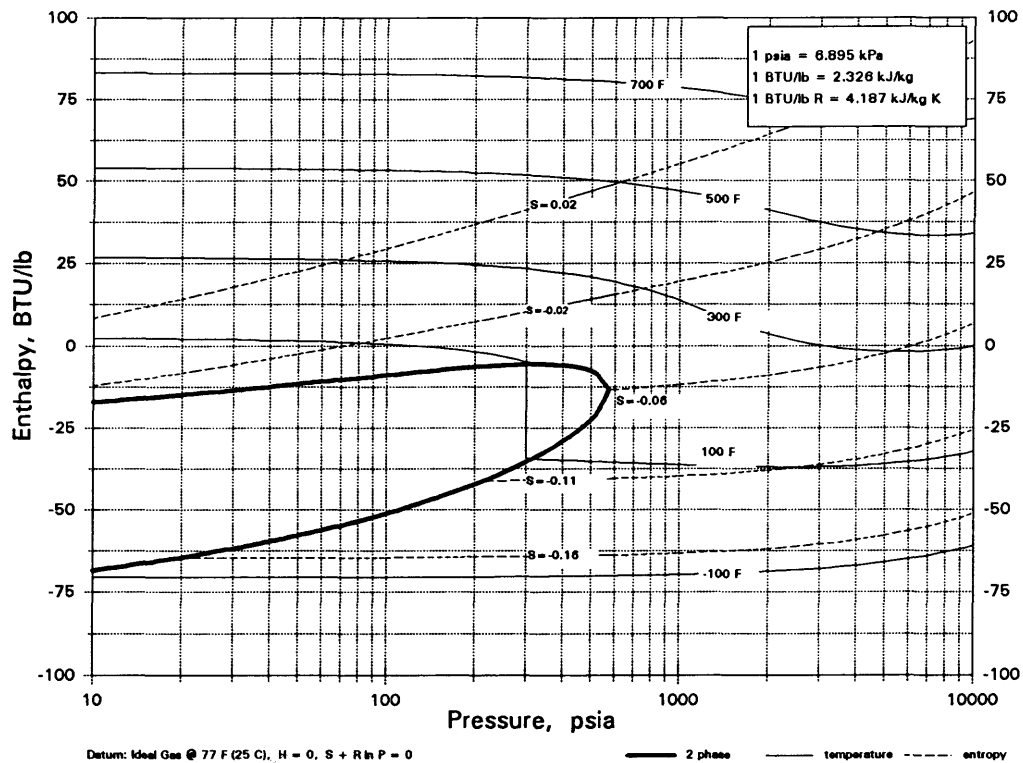
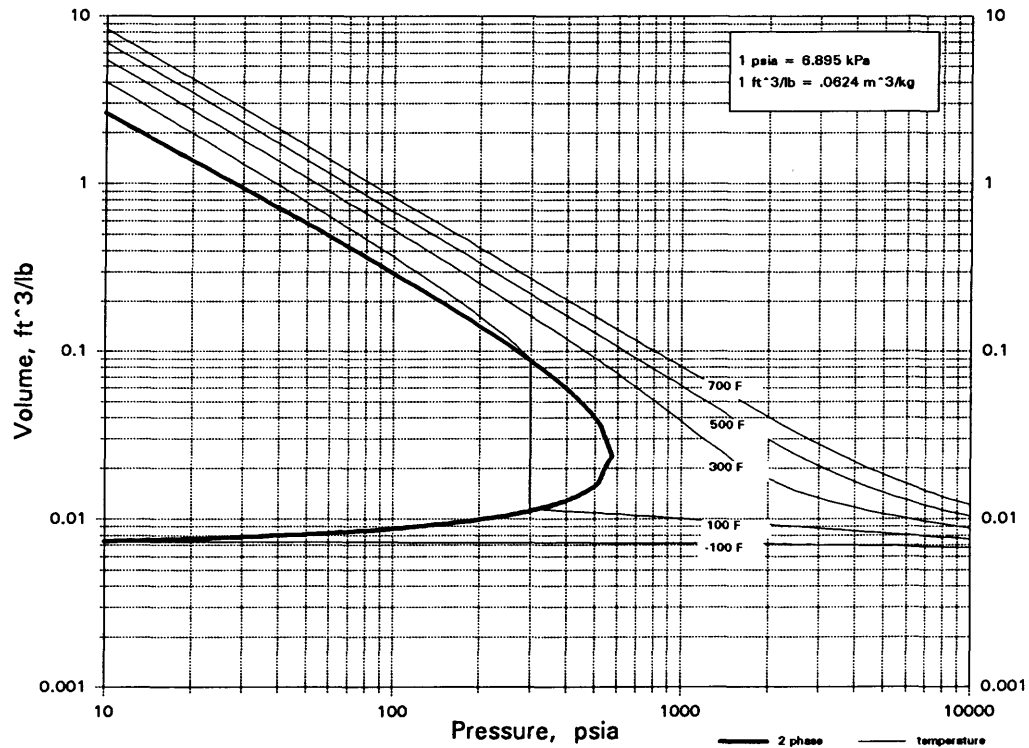


CBrCl₃
BROMOTRICHLOROMETHANE



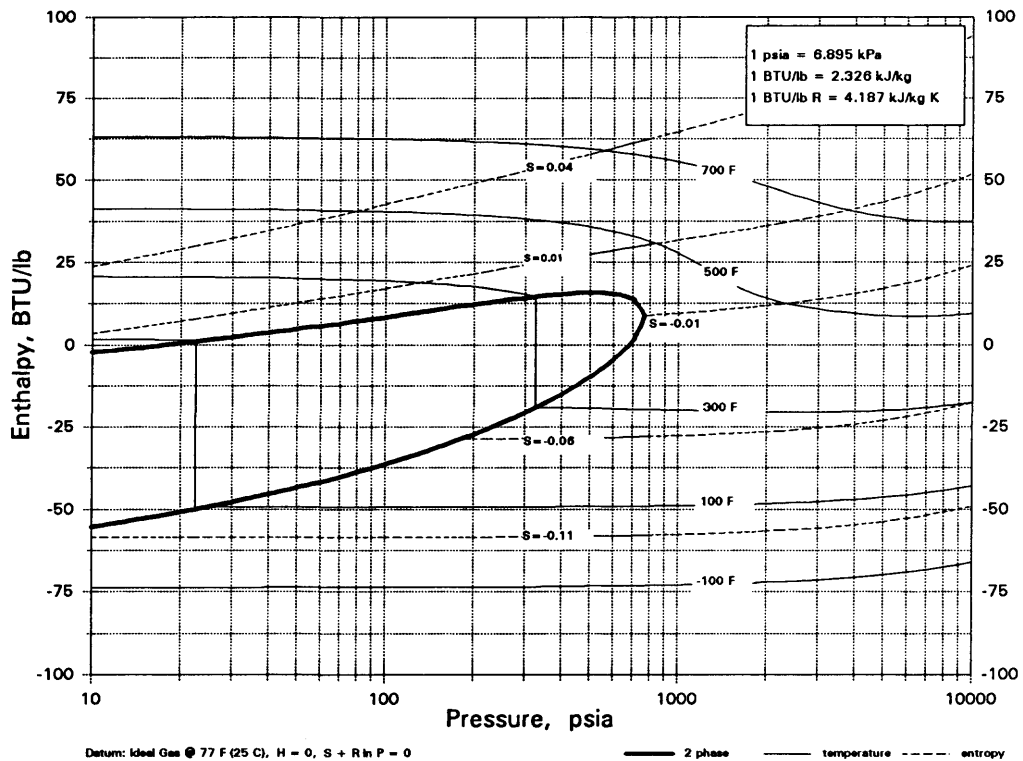
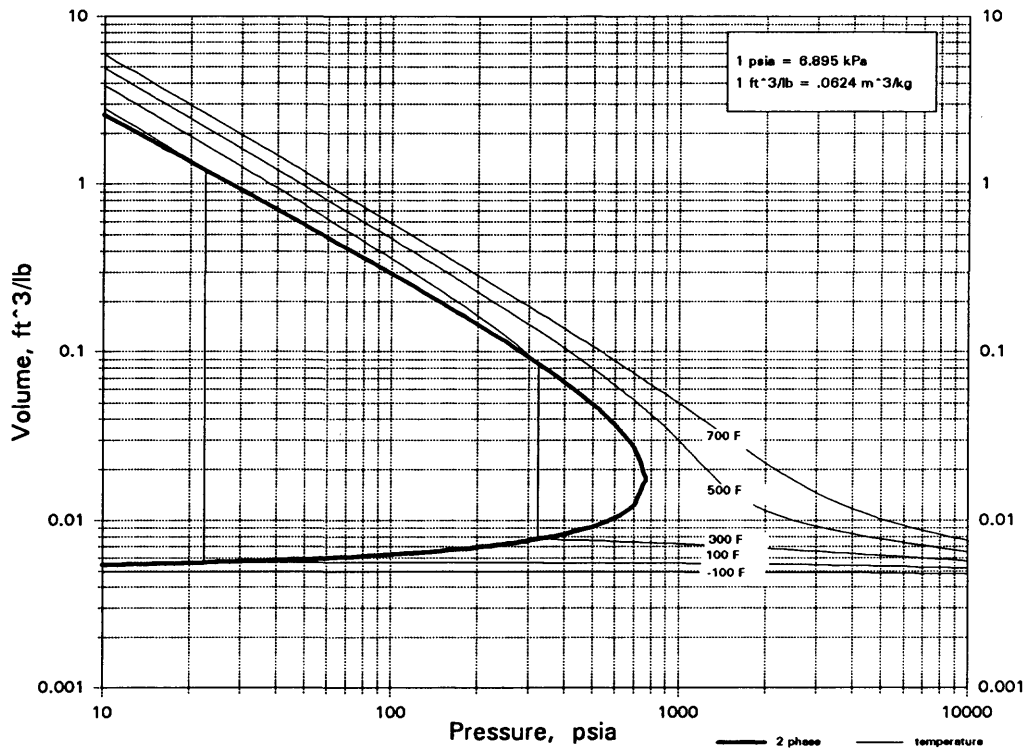
CBrF₃

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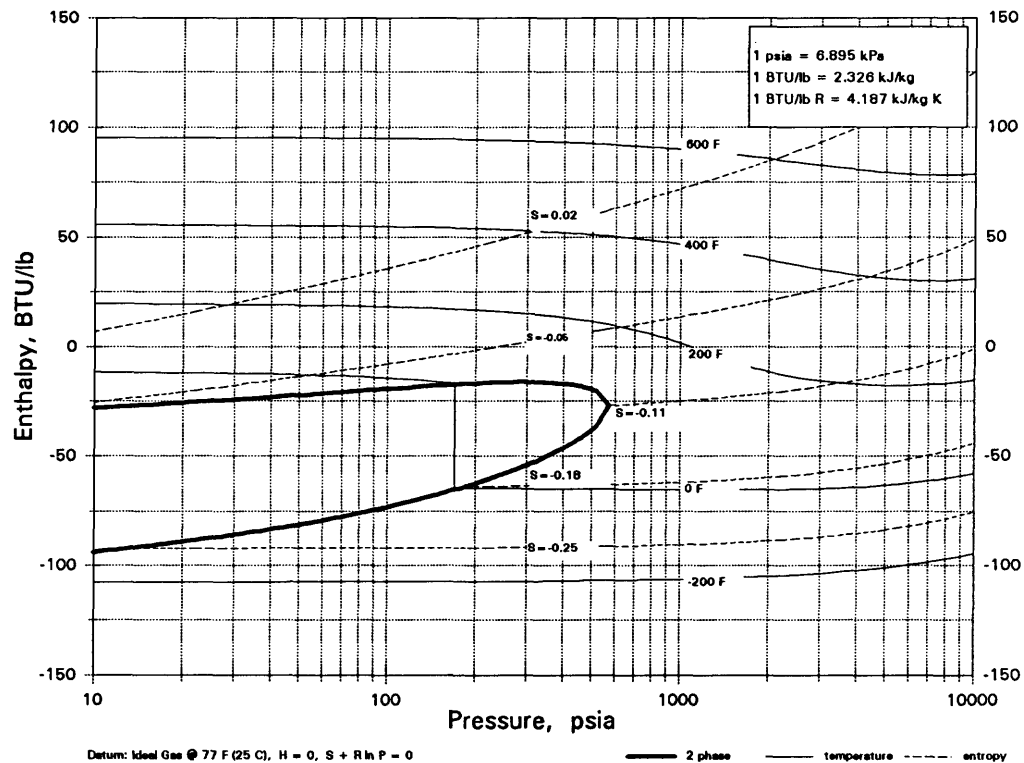
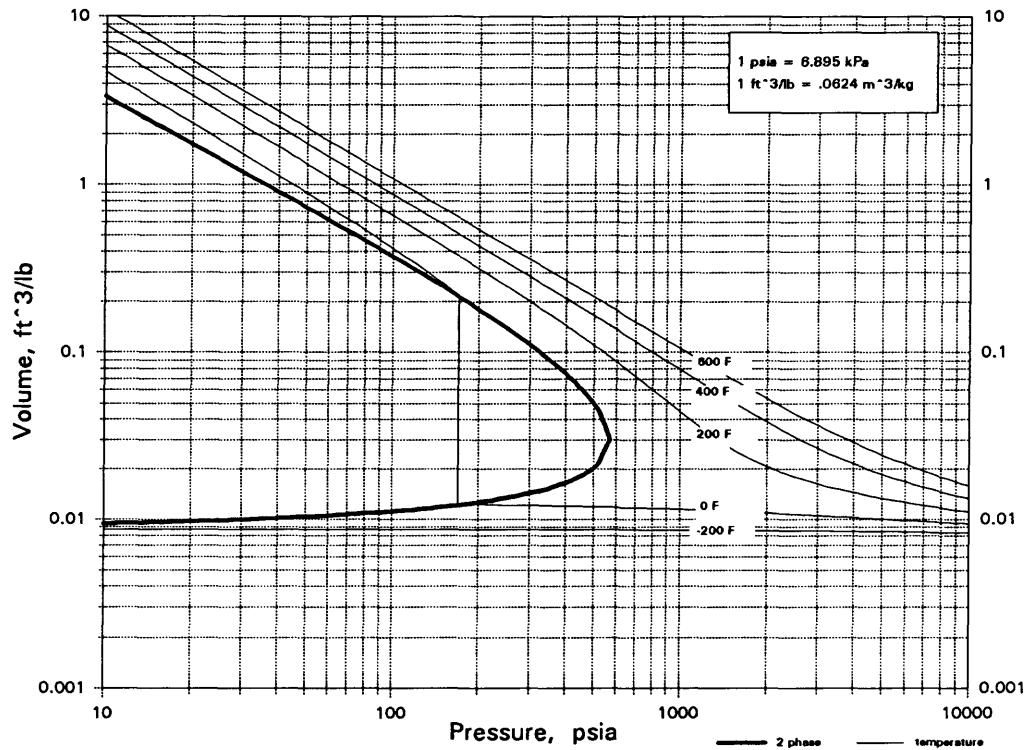
CB₂F₂

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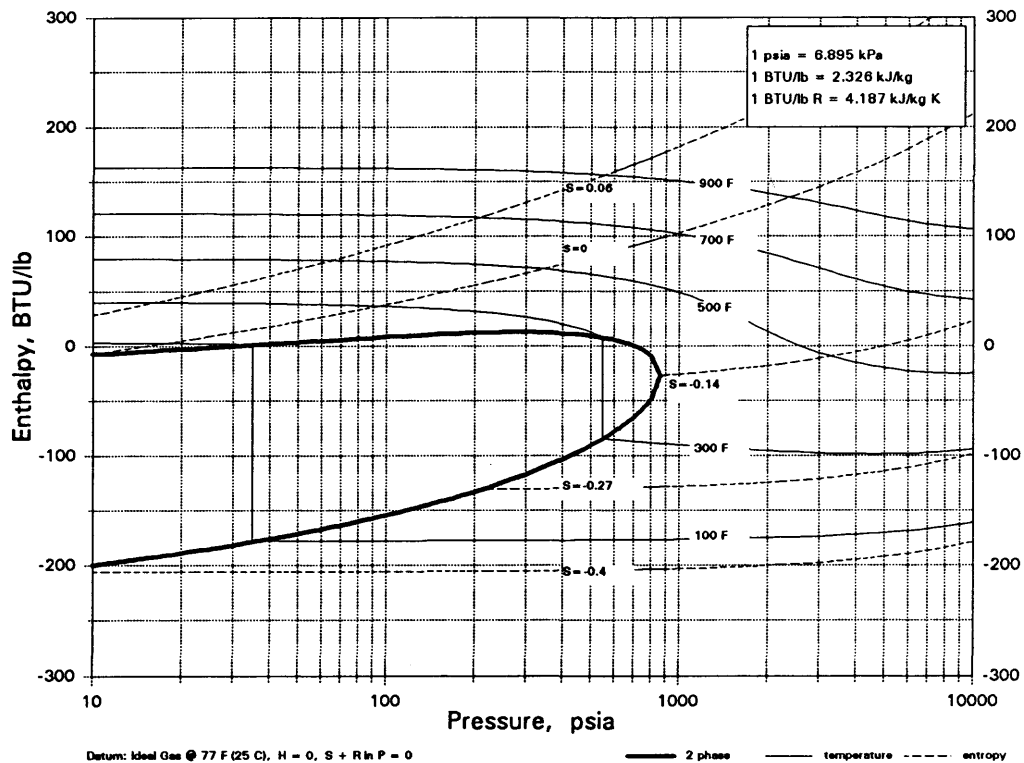
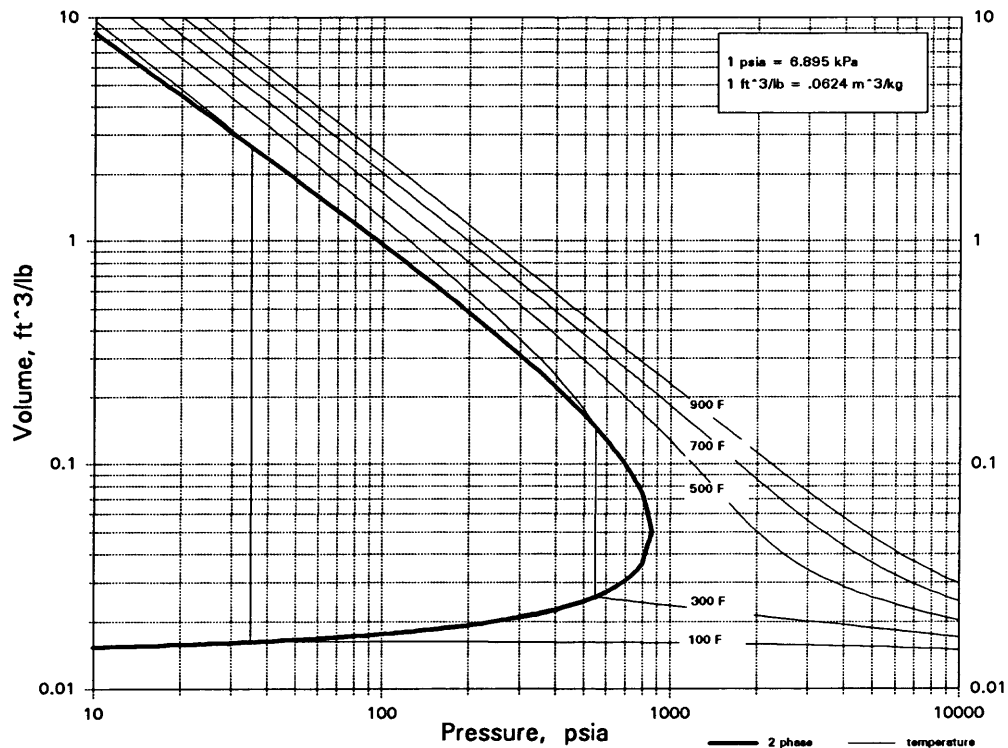
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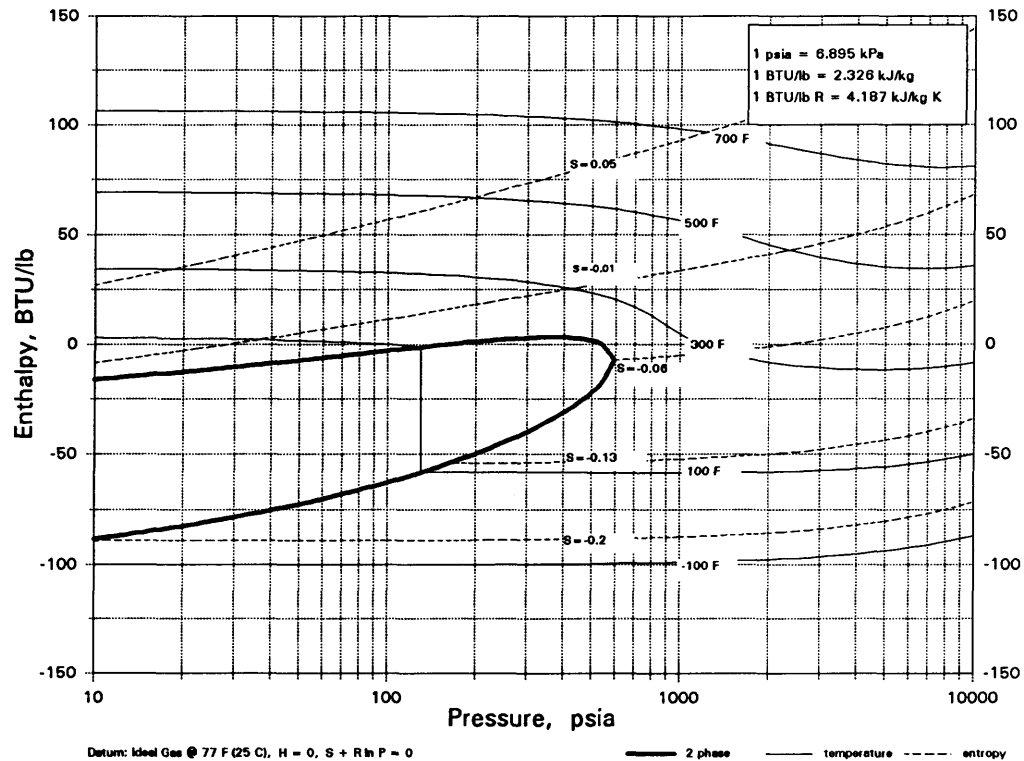
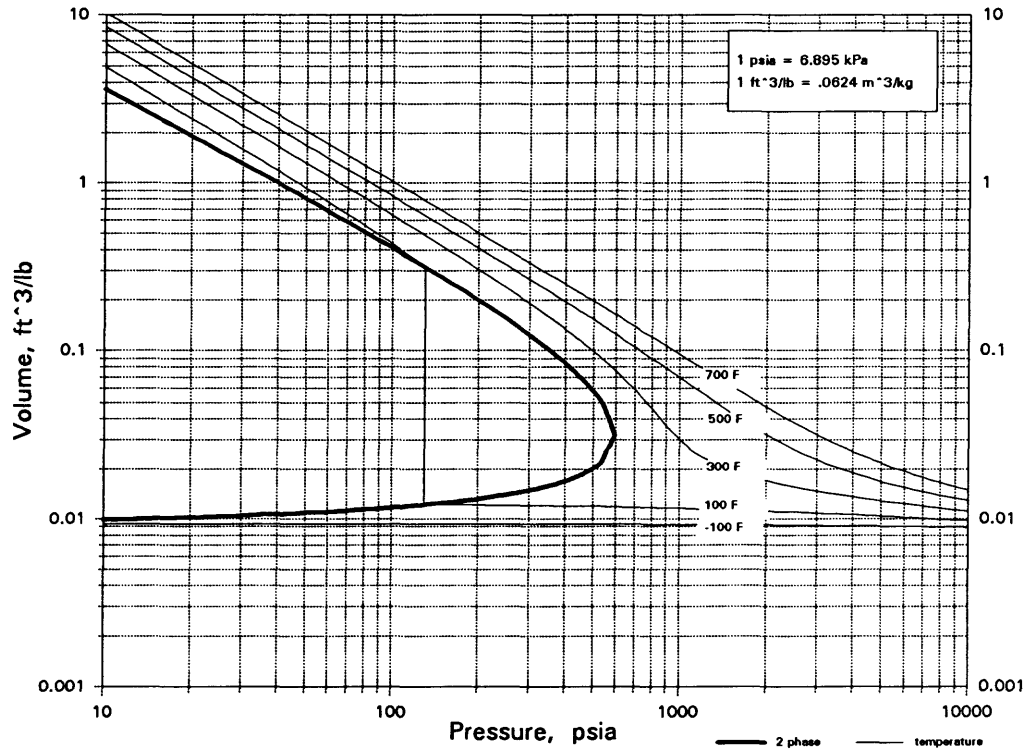
CCIN

CYANOGEN CHLORIDE



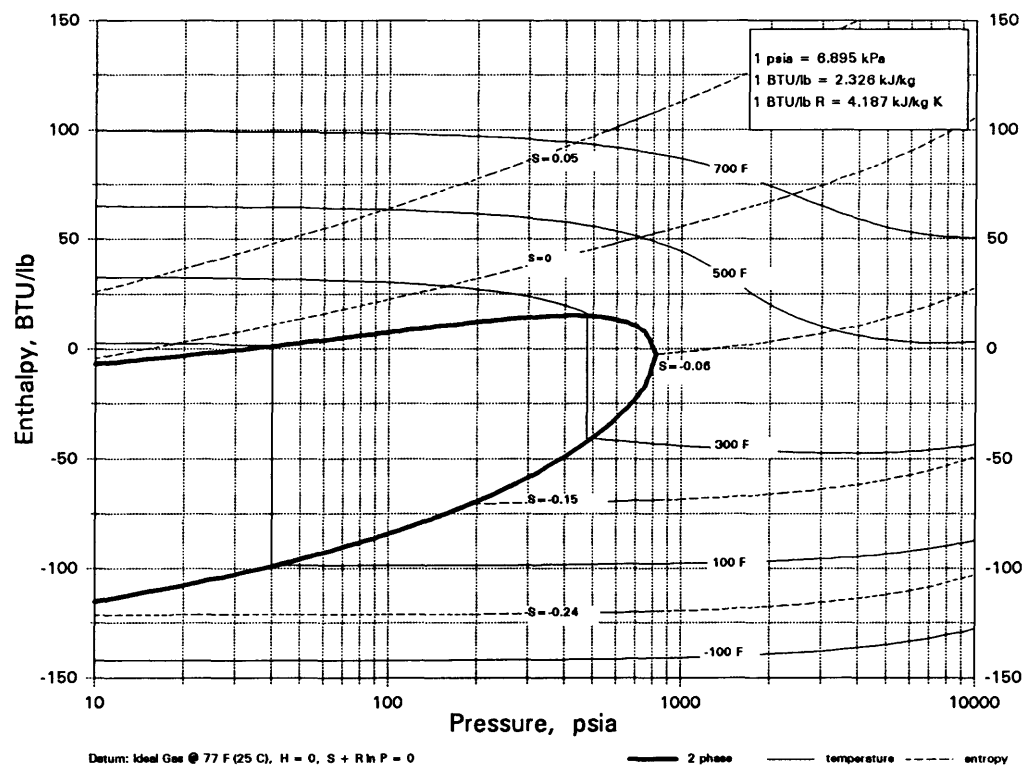
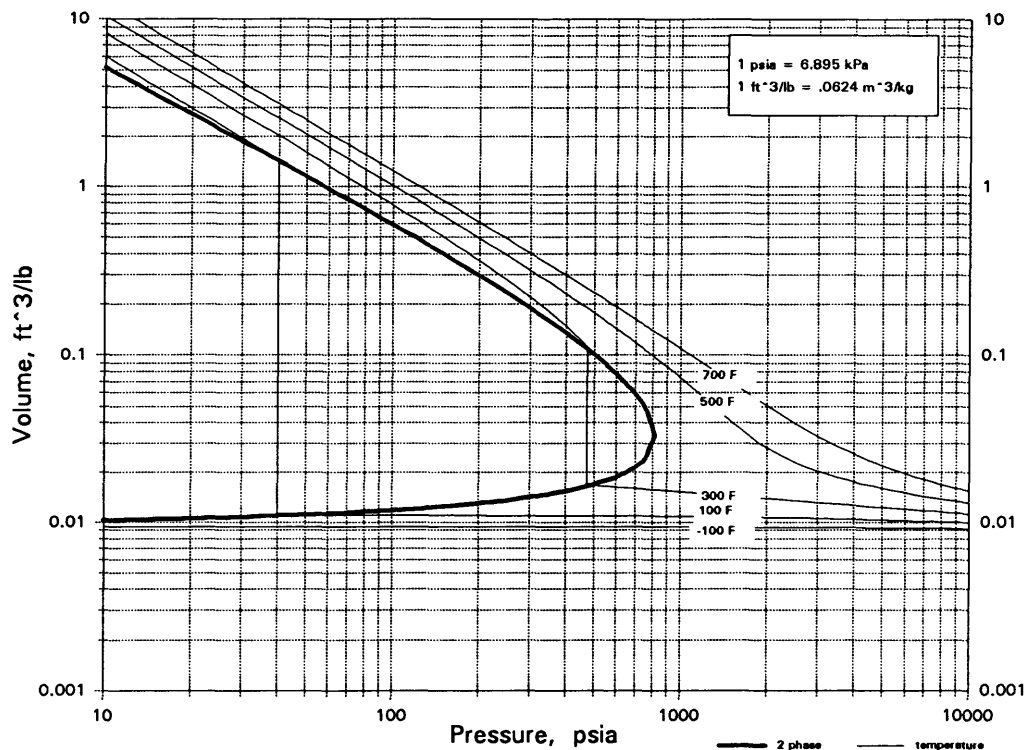
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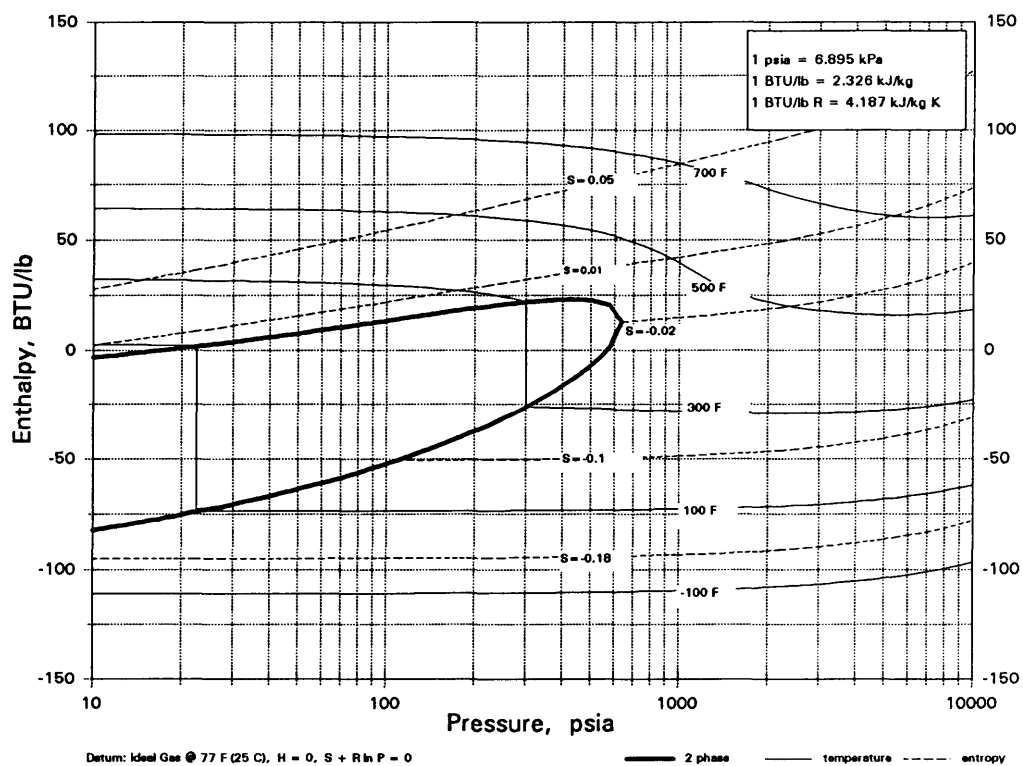
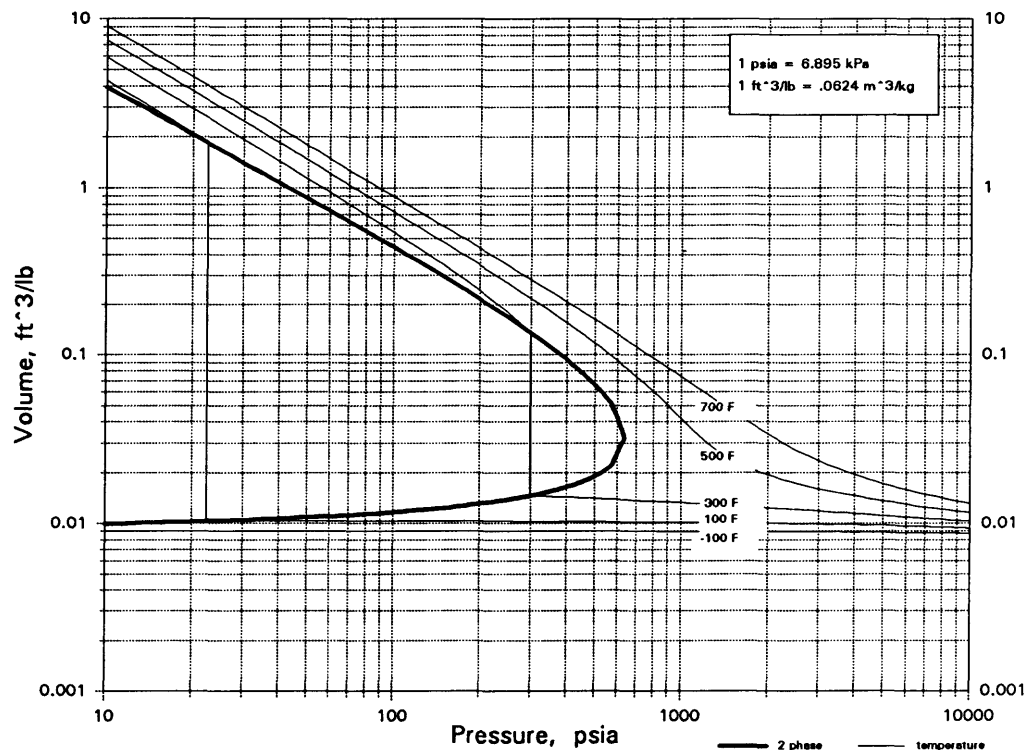
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PHOSGENE



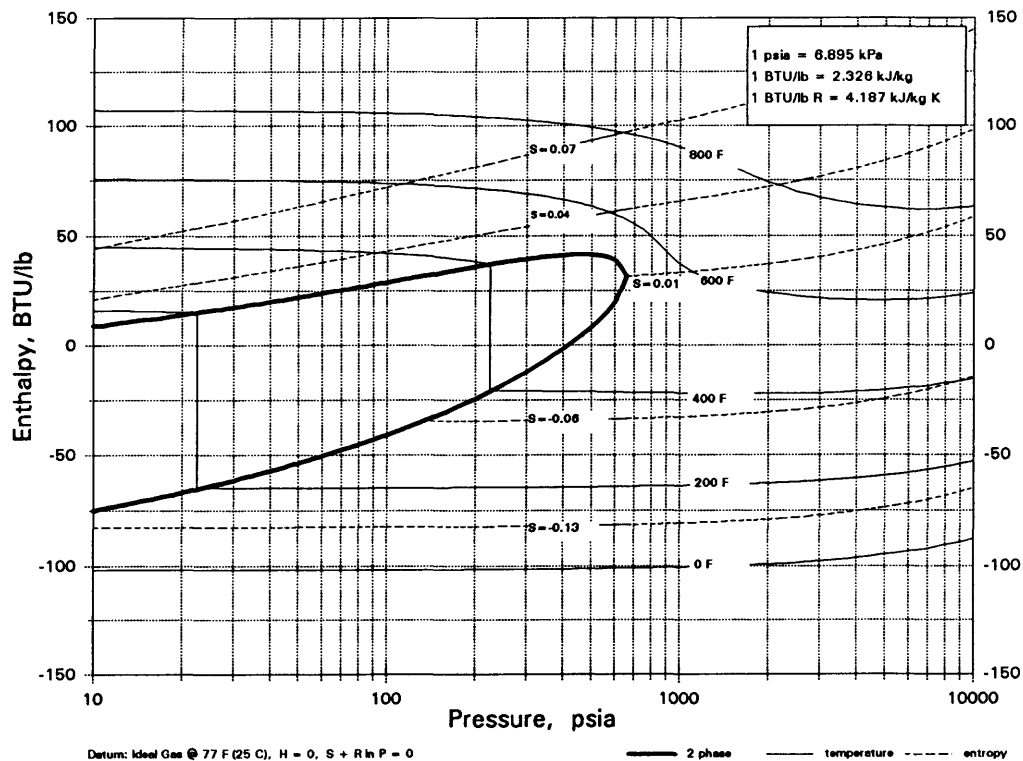
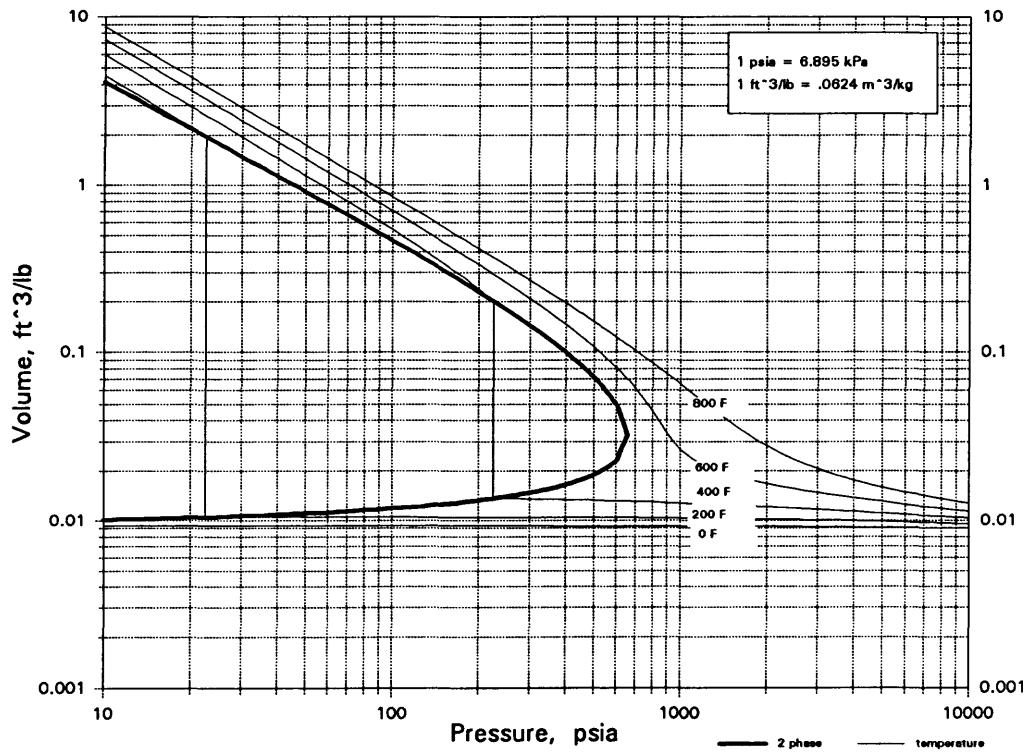
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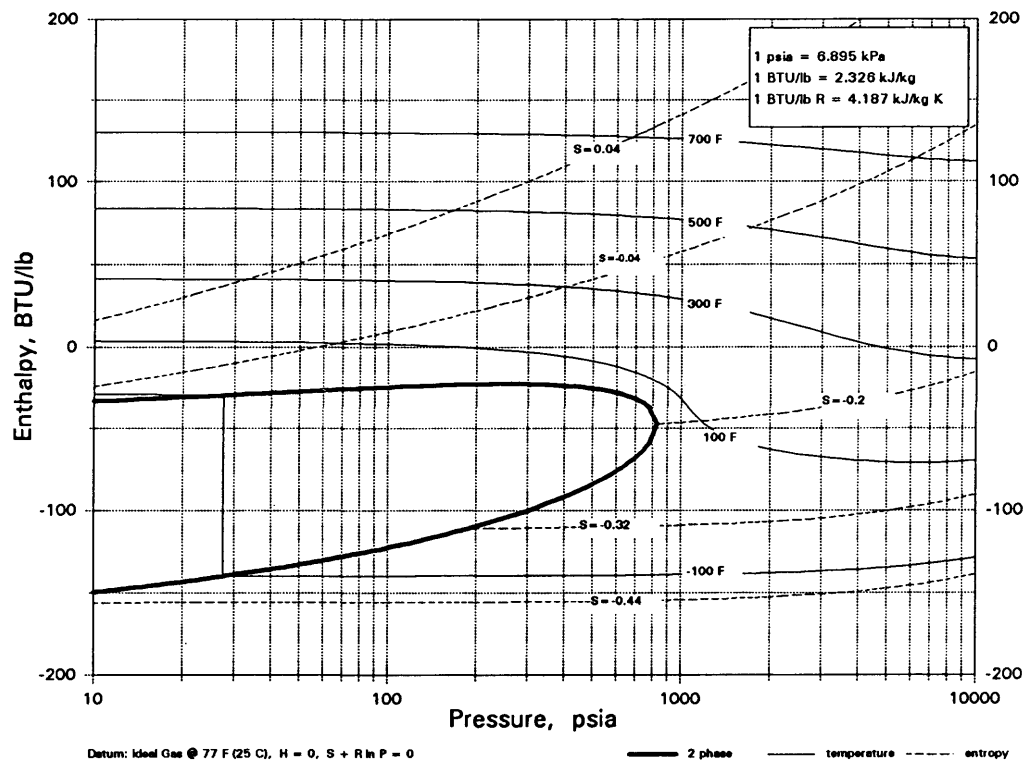
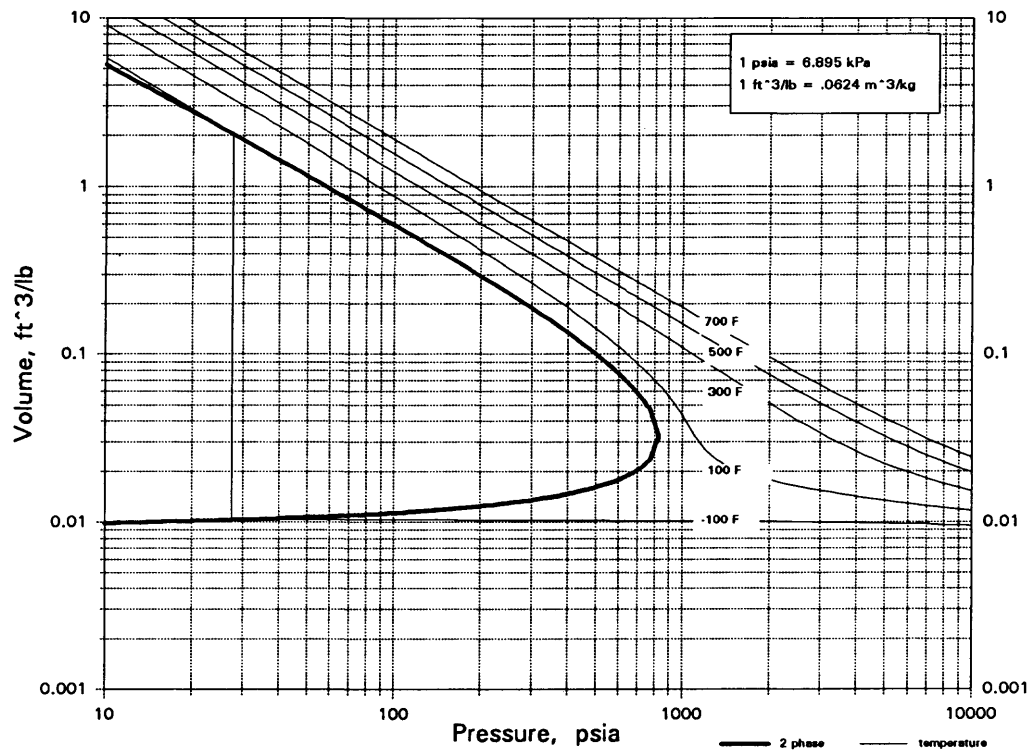
CCl₄

CARBON TETRACHLORIDE

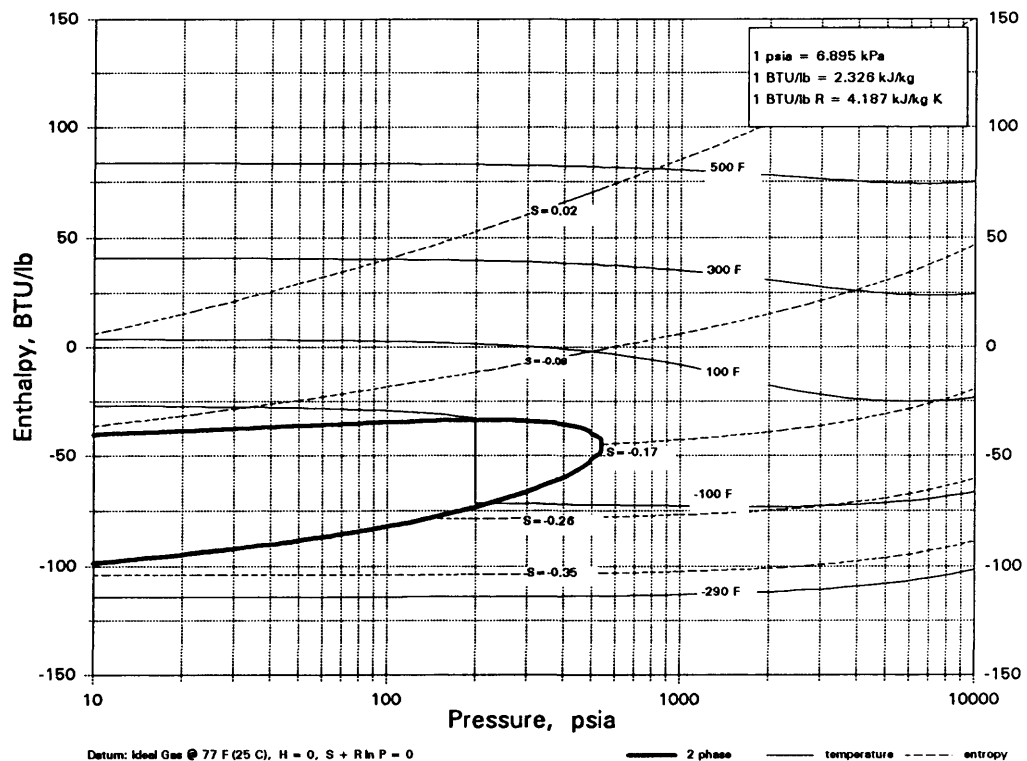
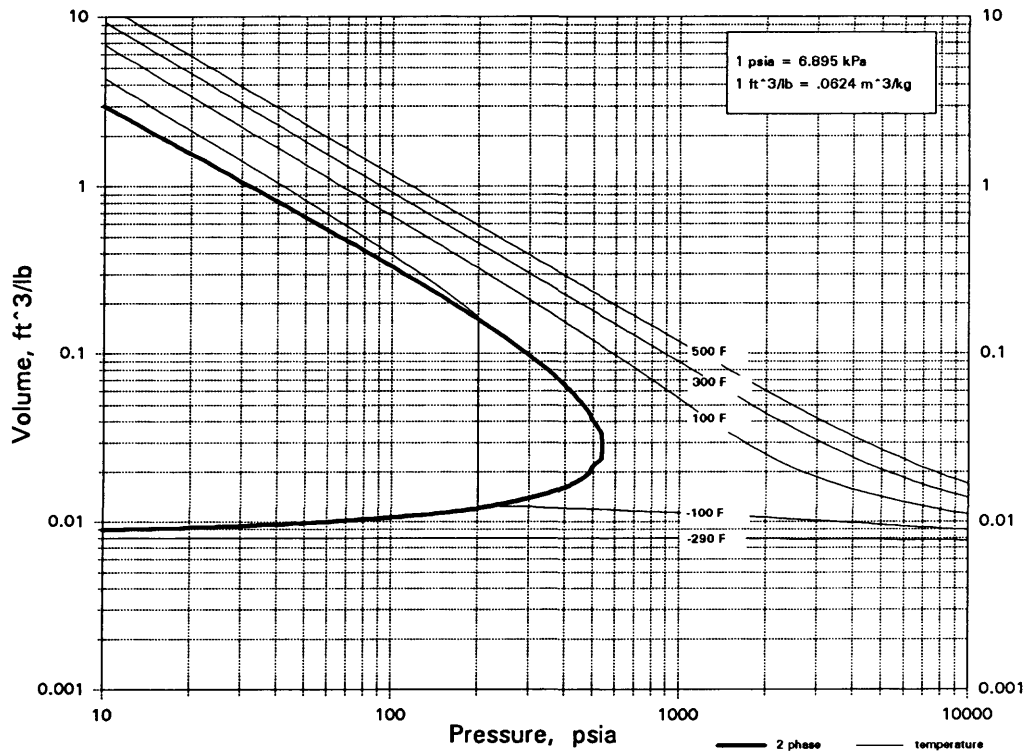


CF2O

CARBONYL FLUORIDE

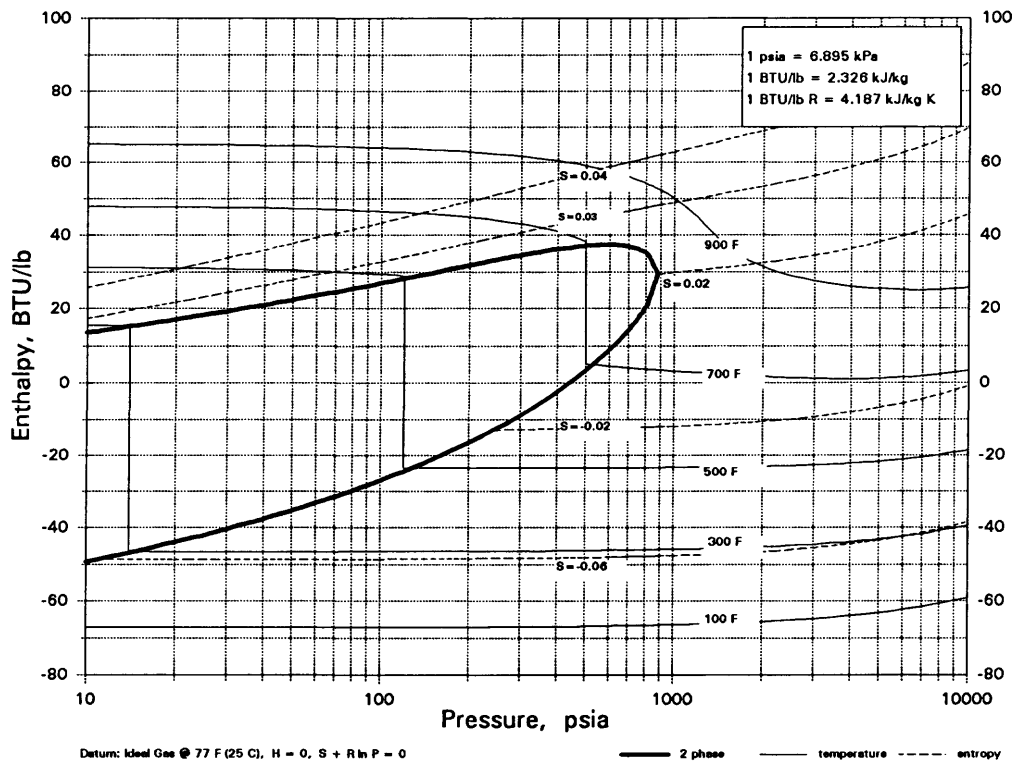
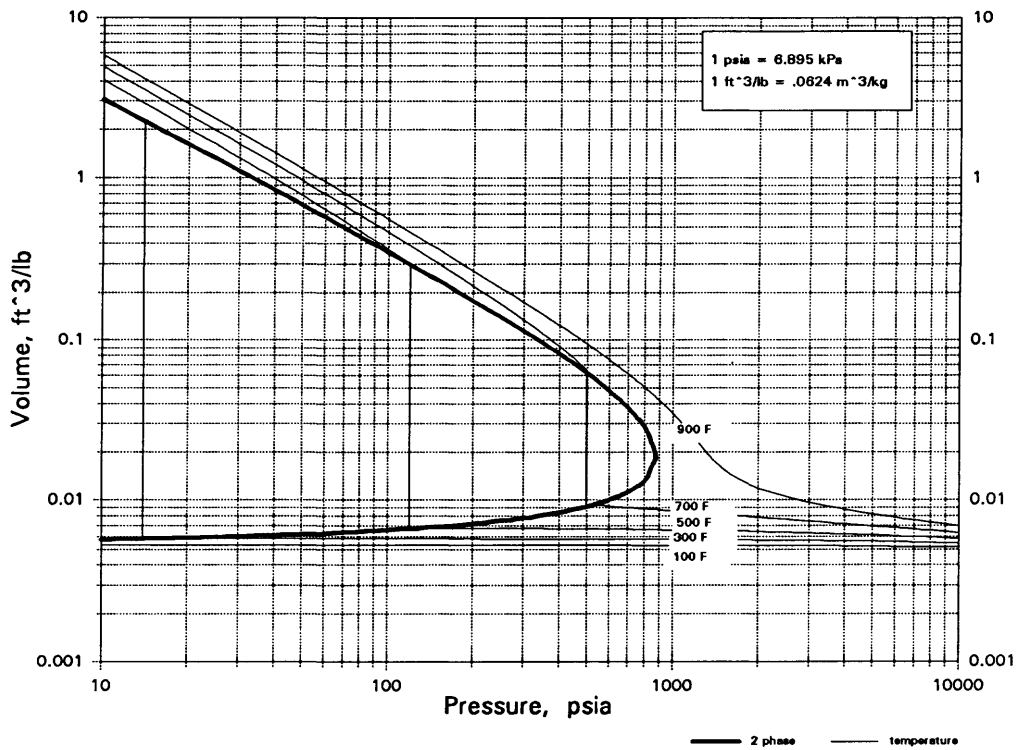


CF4
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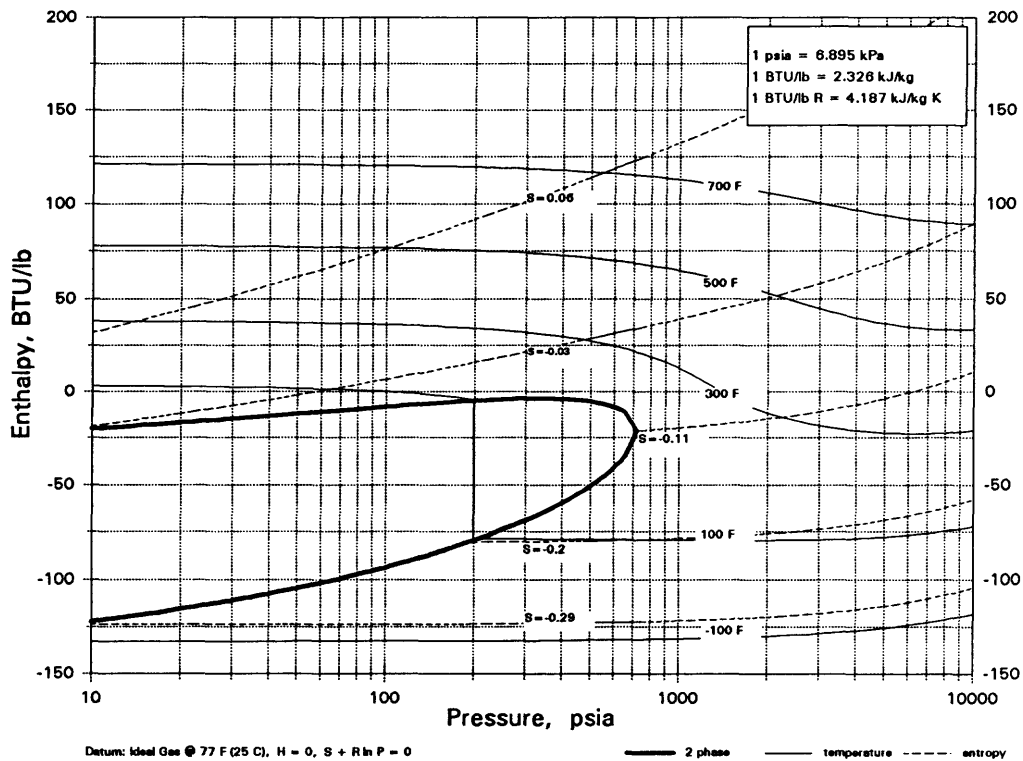
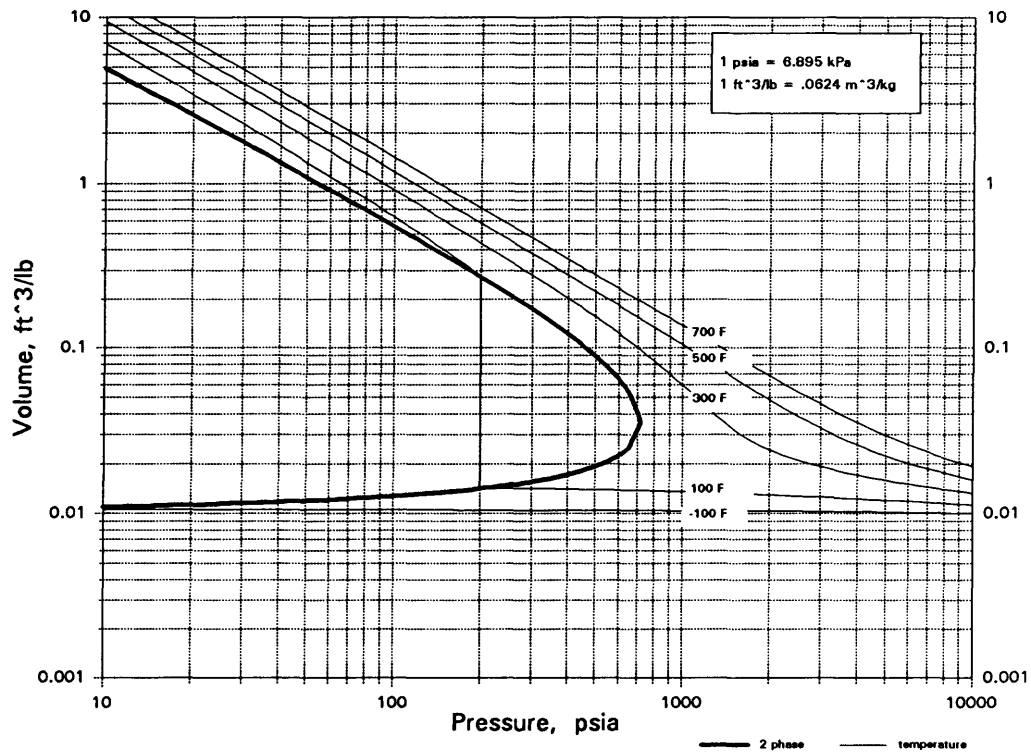


CHBr₃

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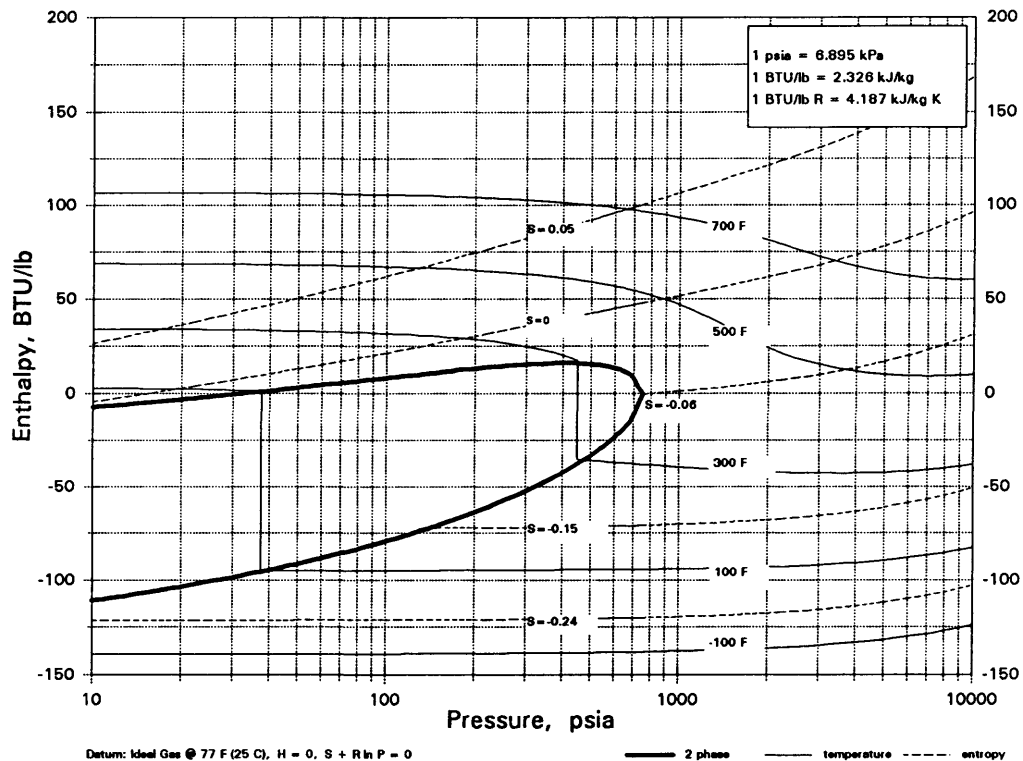
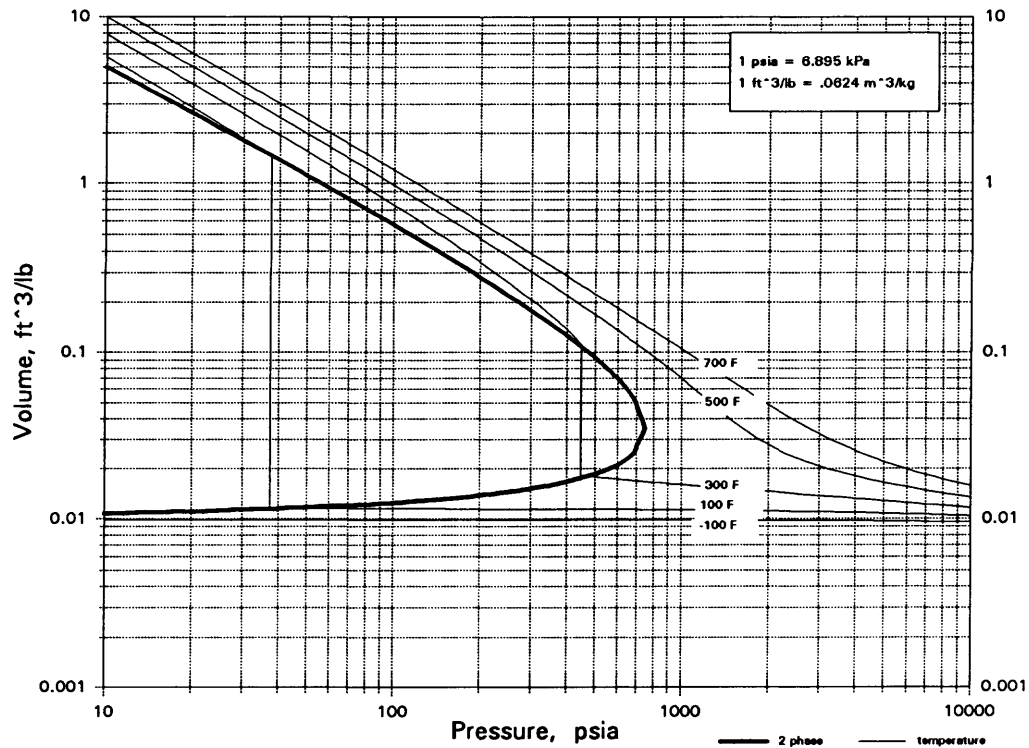


CHClF₂
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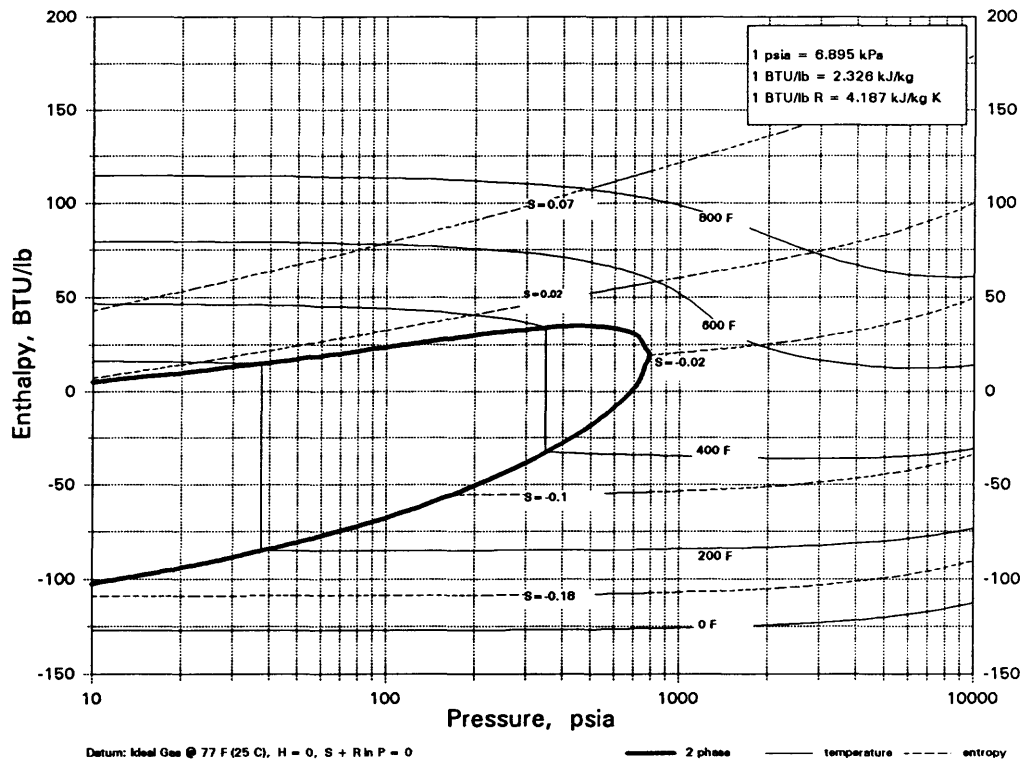
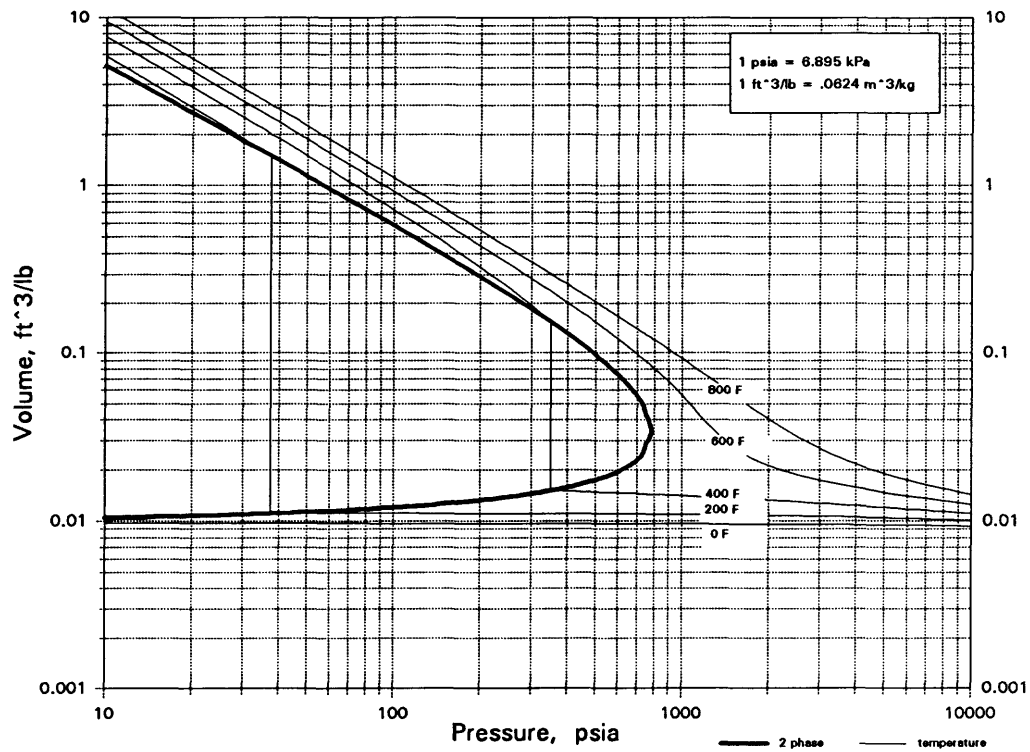
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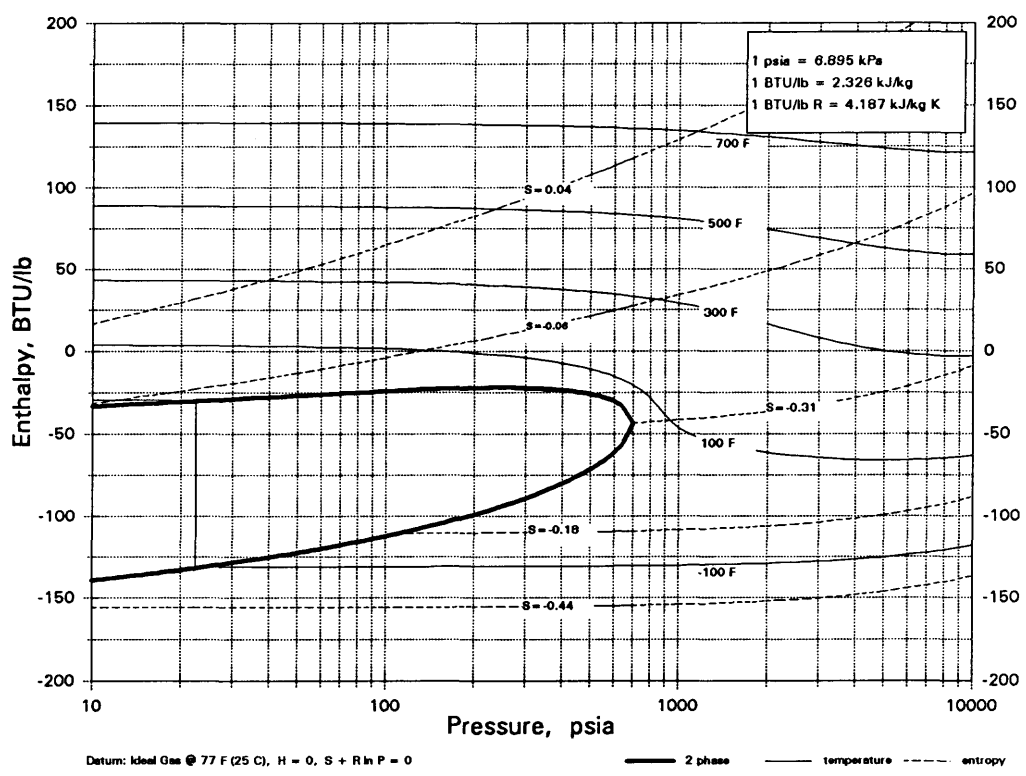
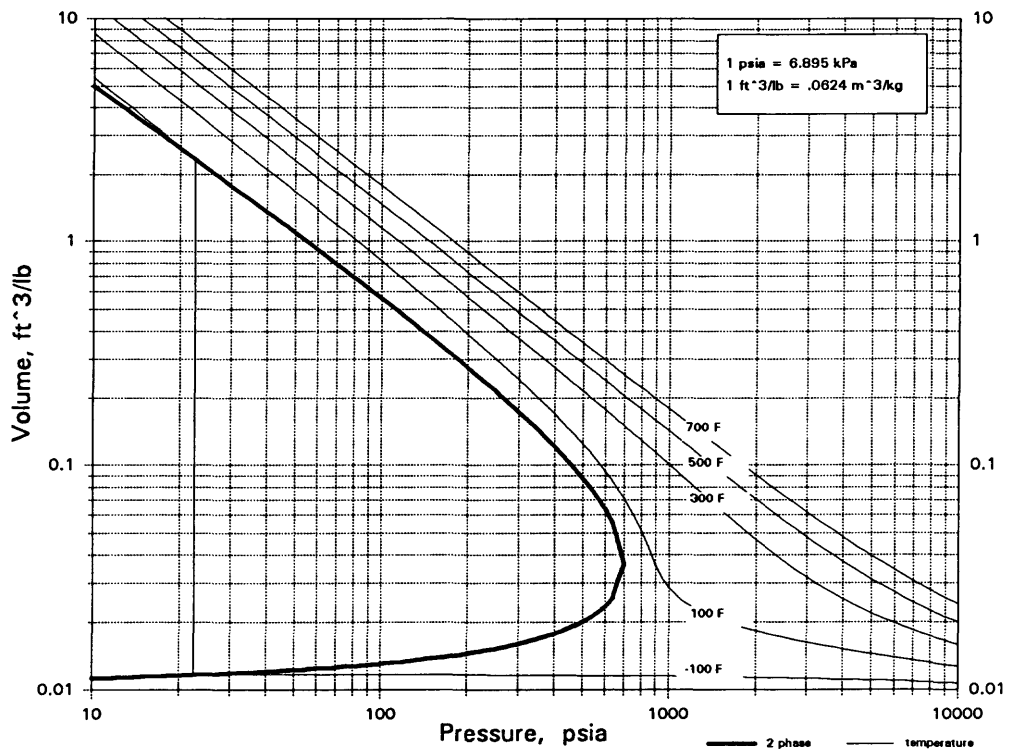


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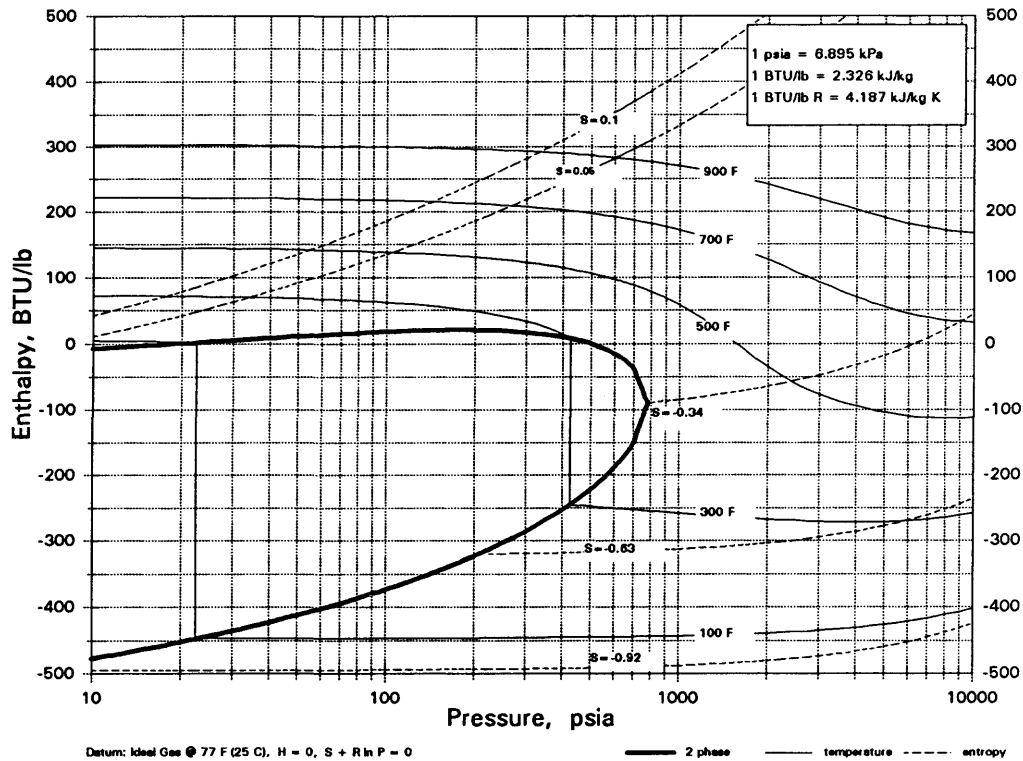
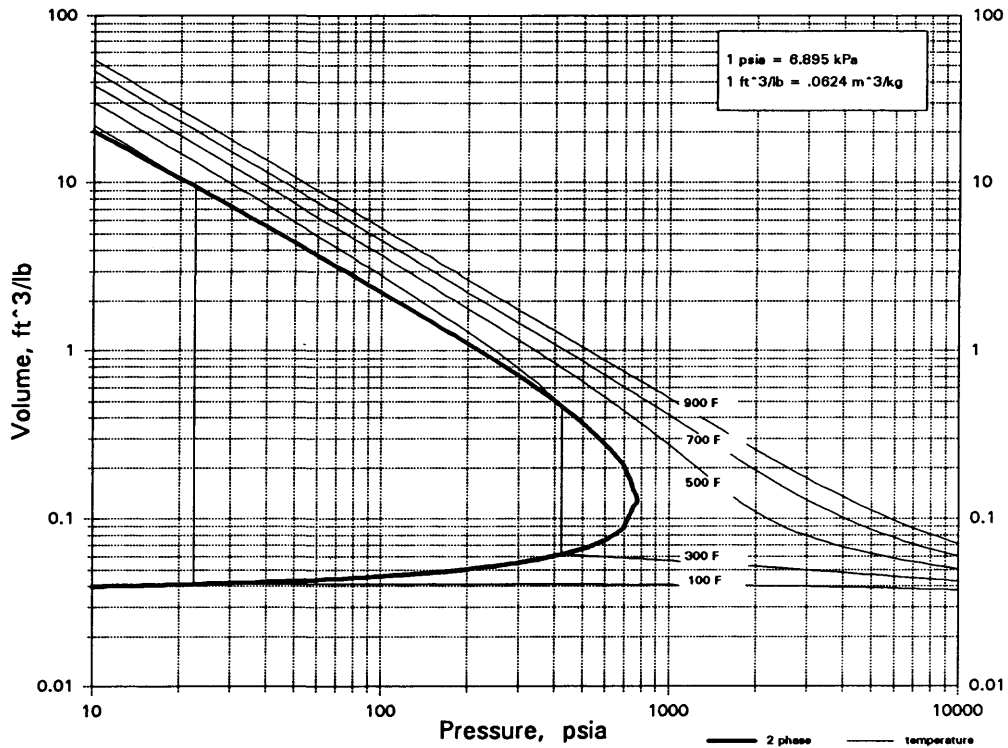
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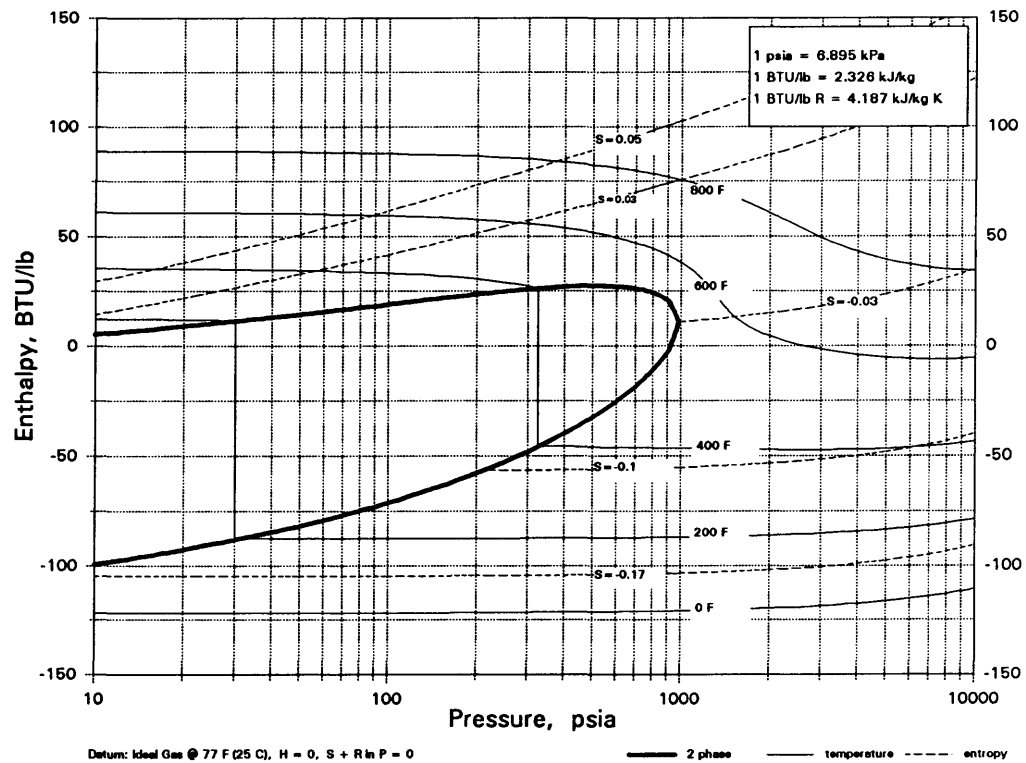
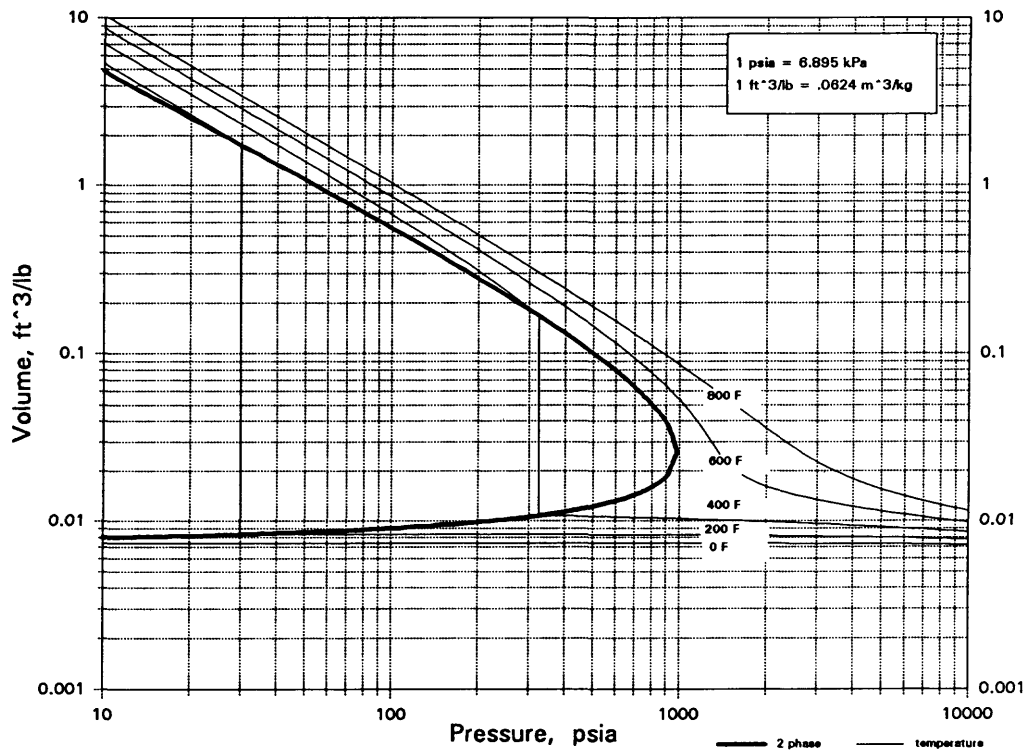
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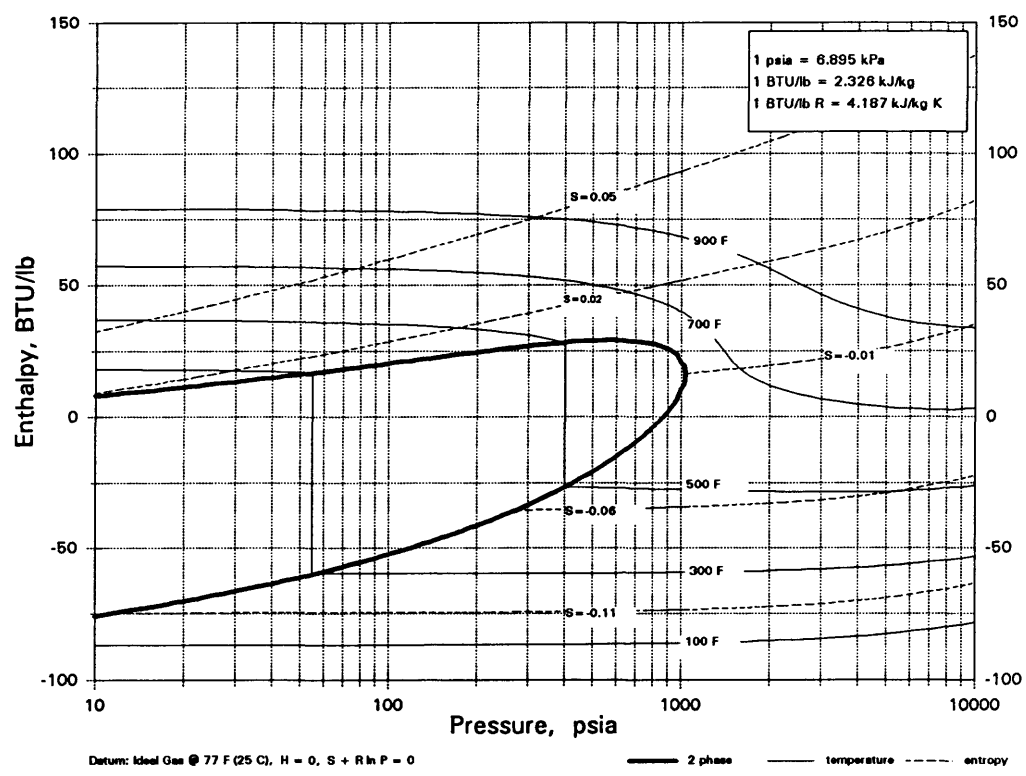
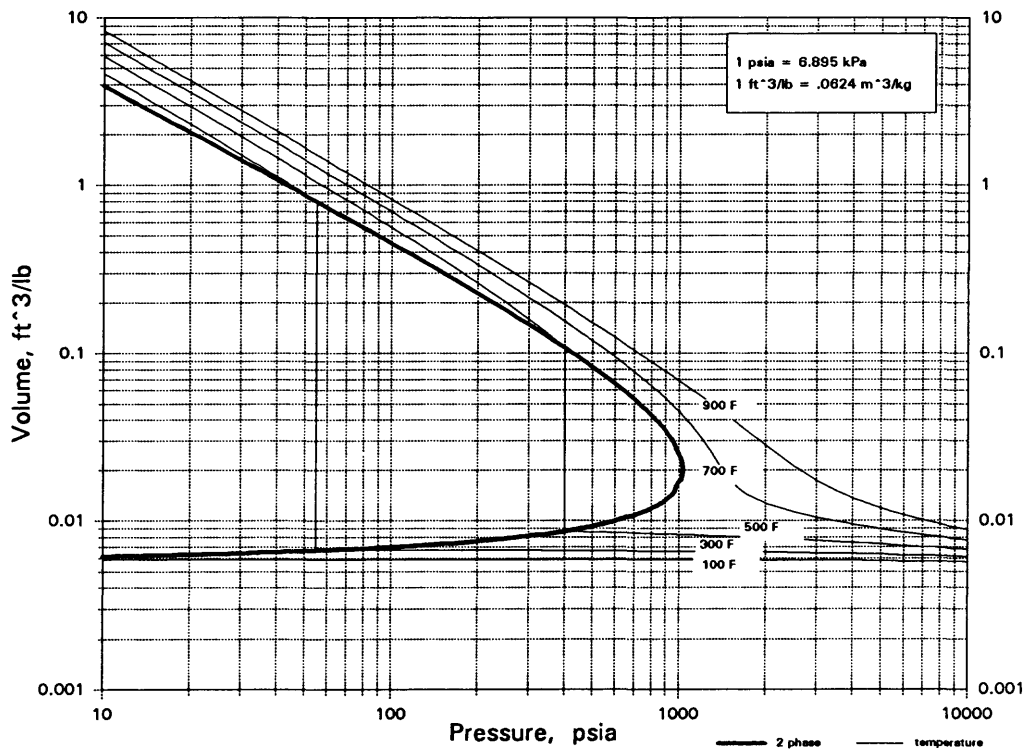
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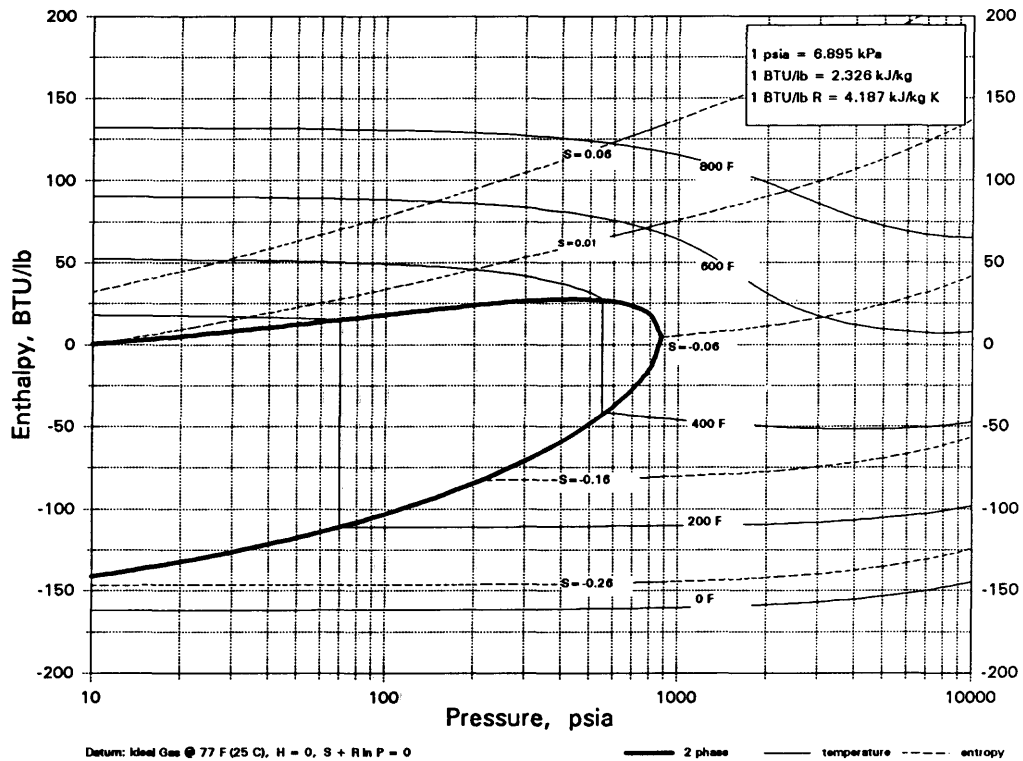
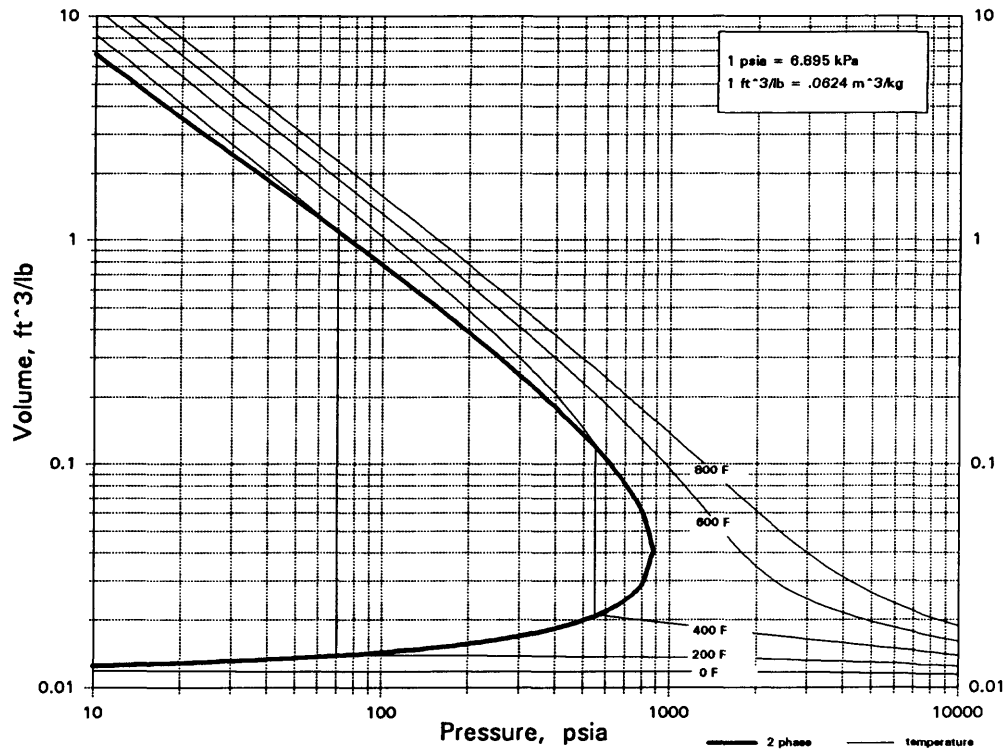


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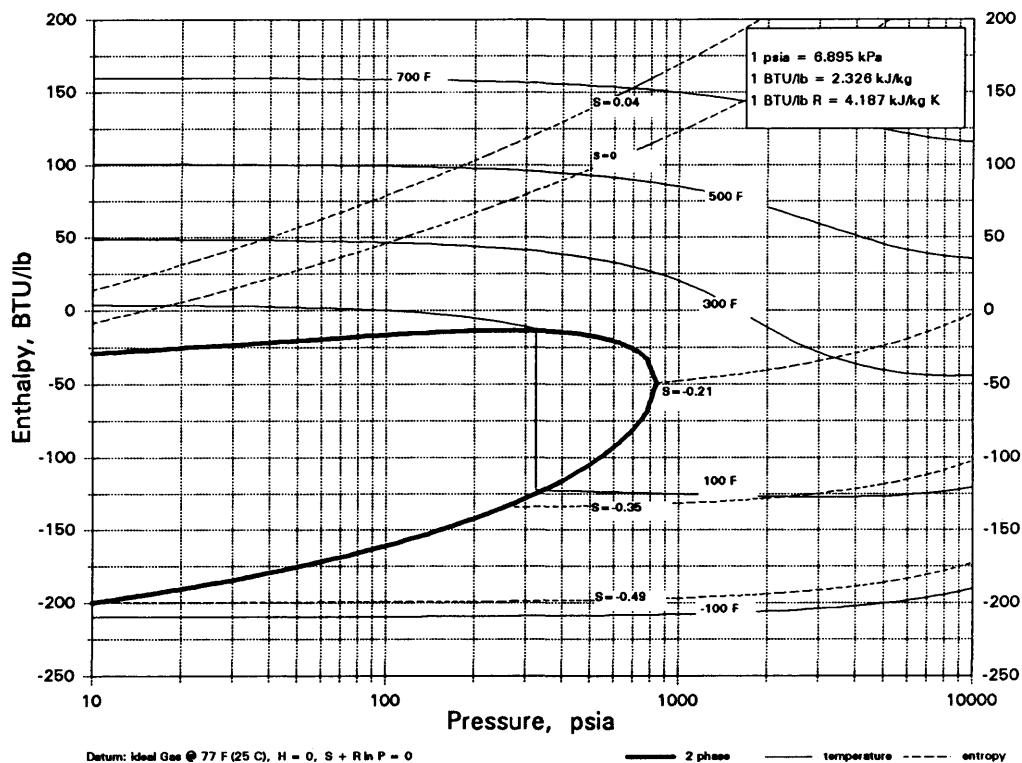
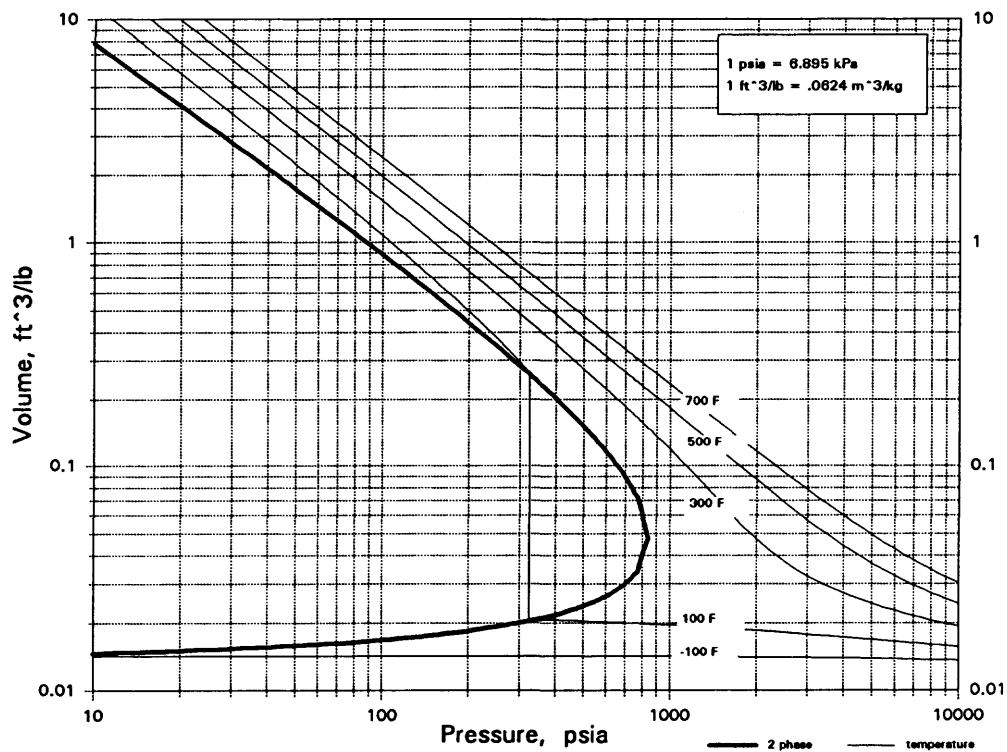


CH₂Cl₂

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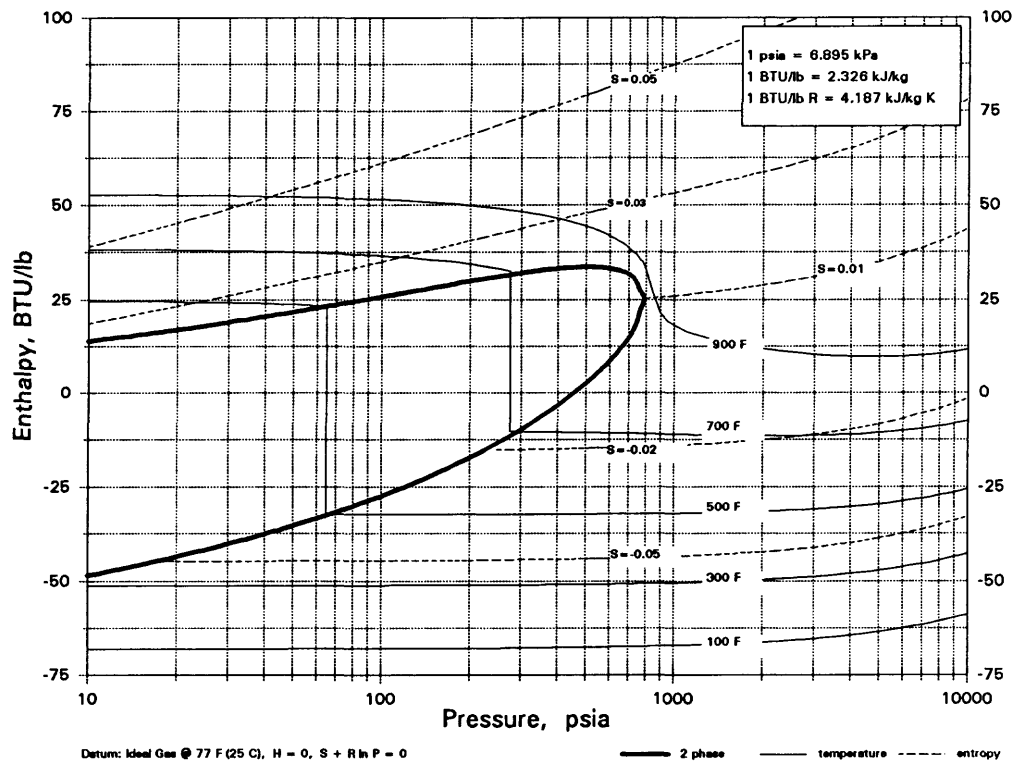
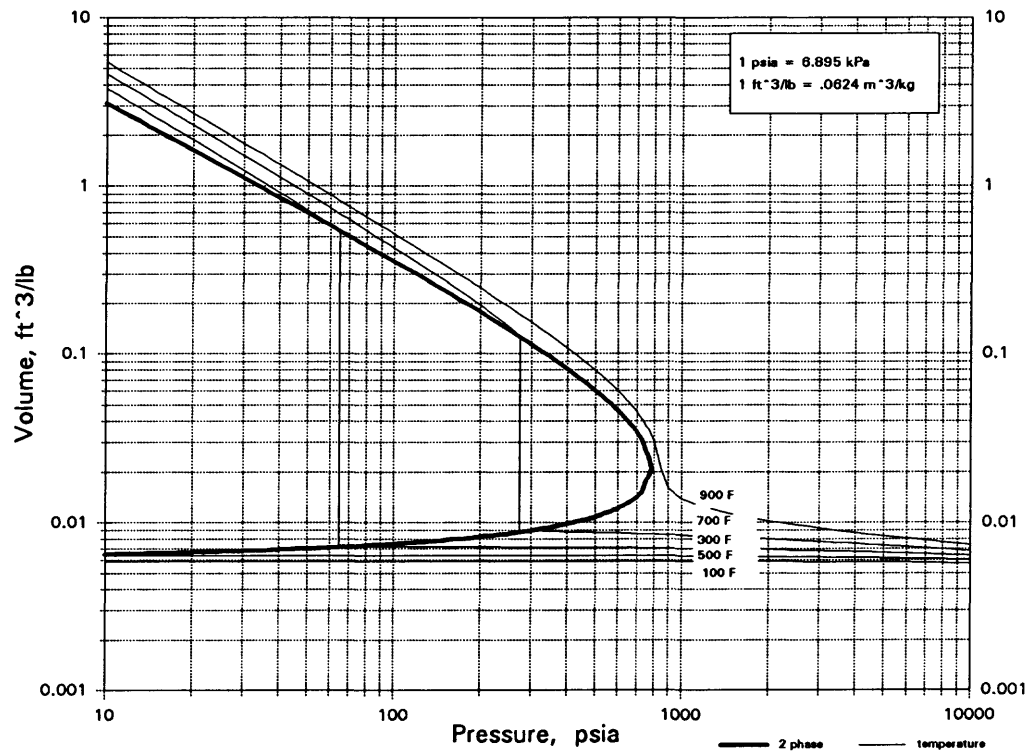


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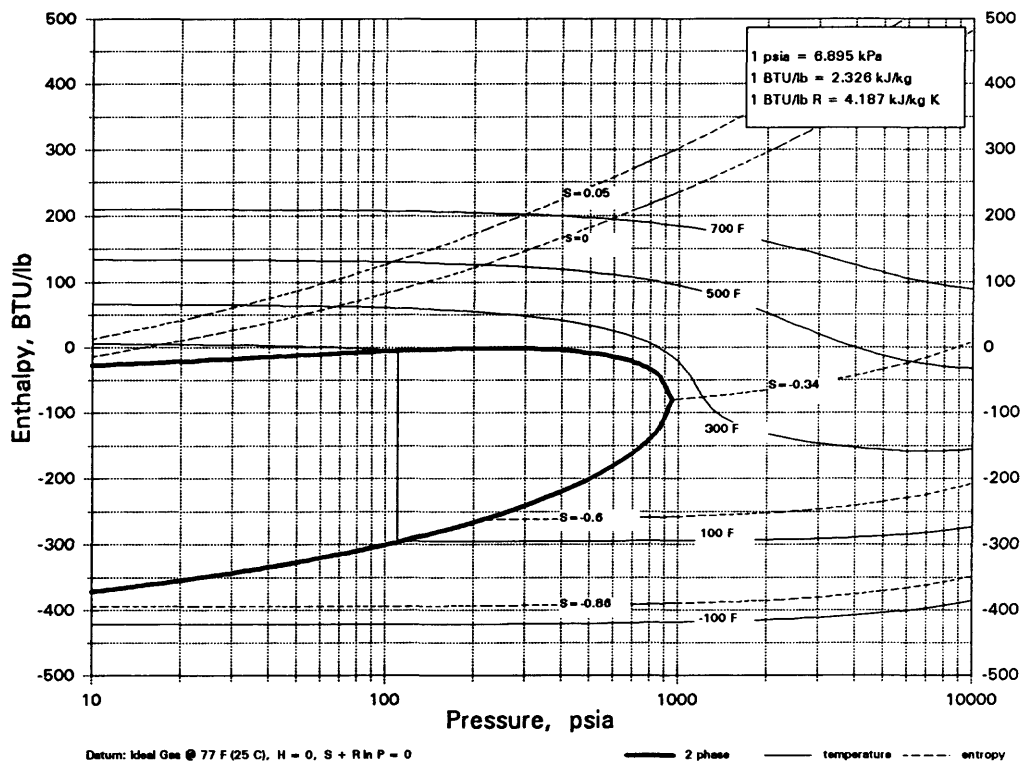
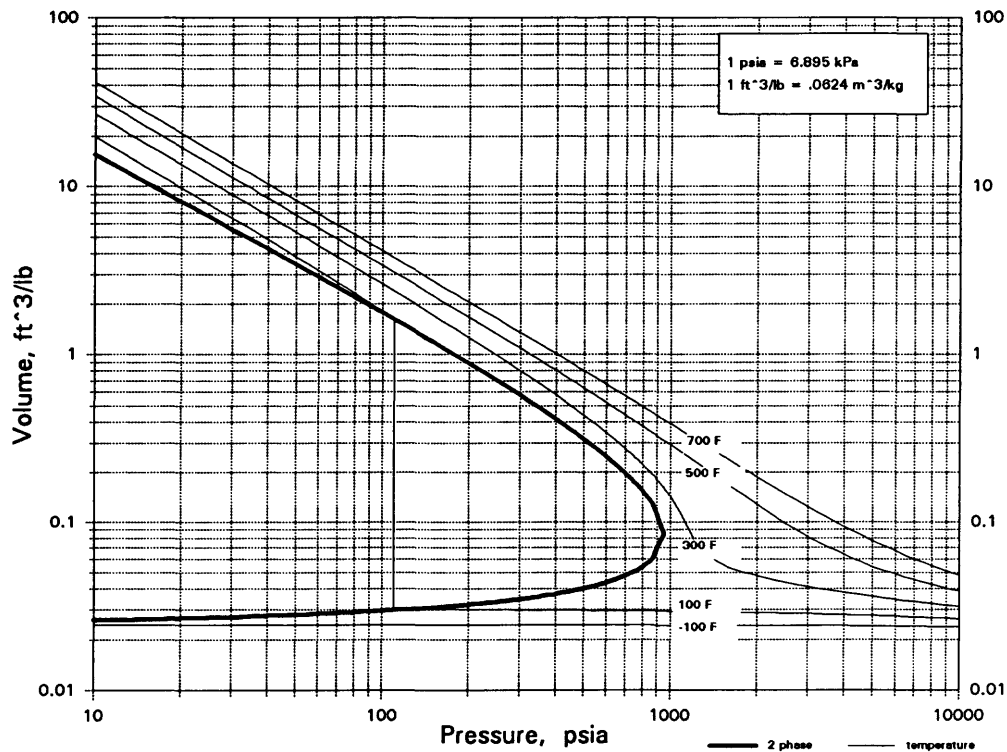


CH₂I₂

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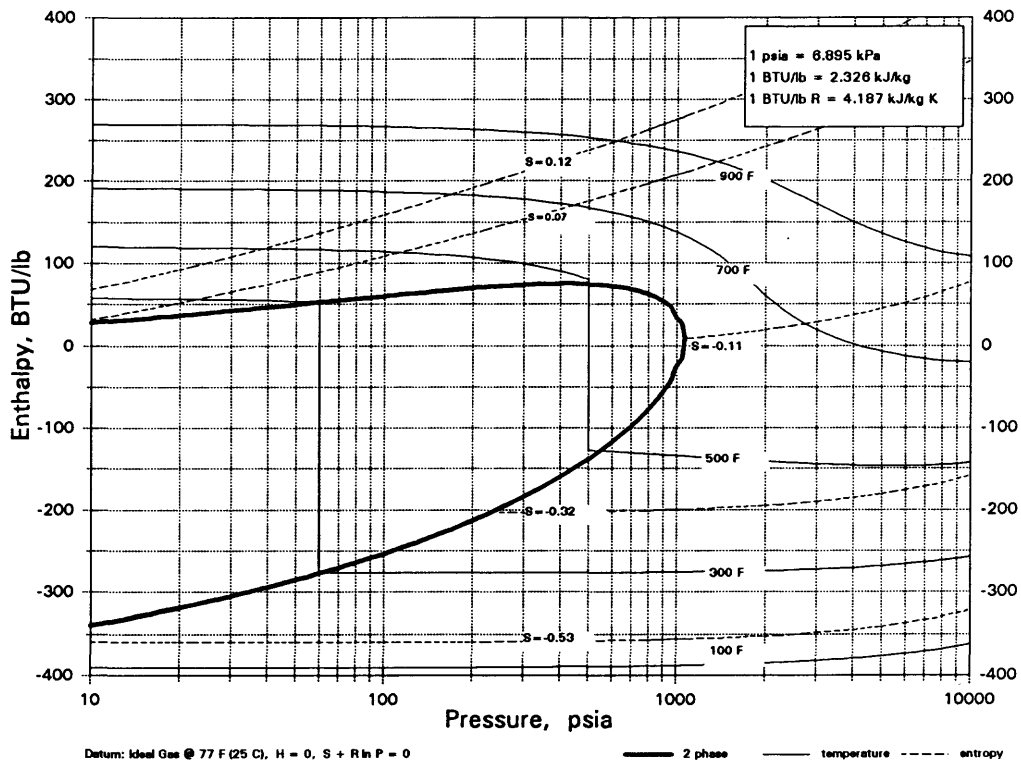
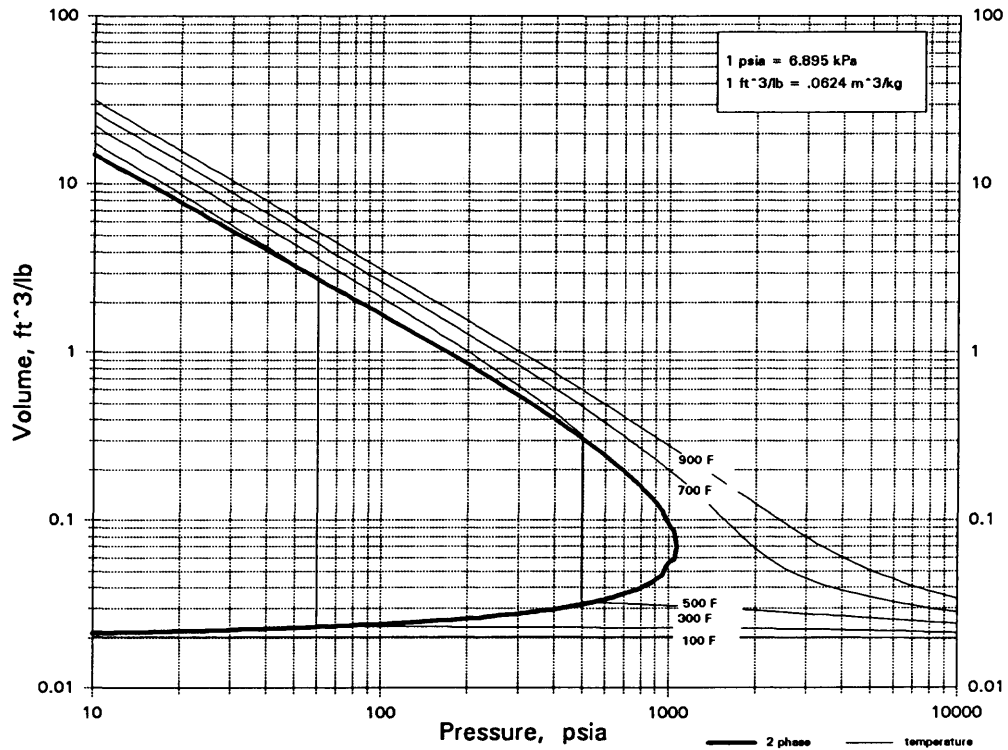


CH₂O
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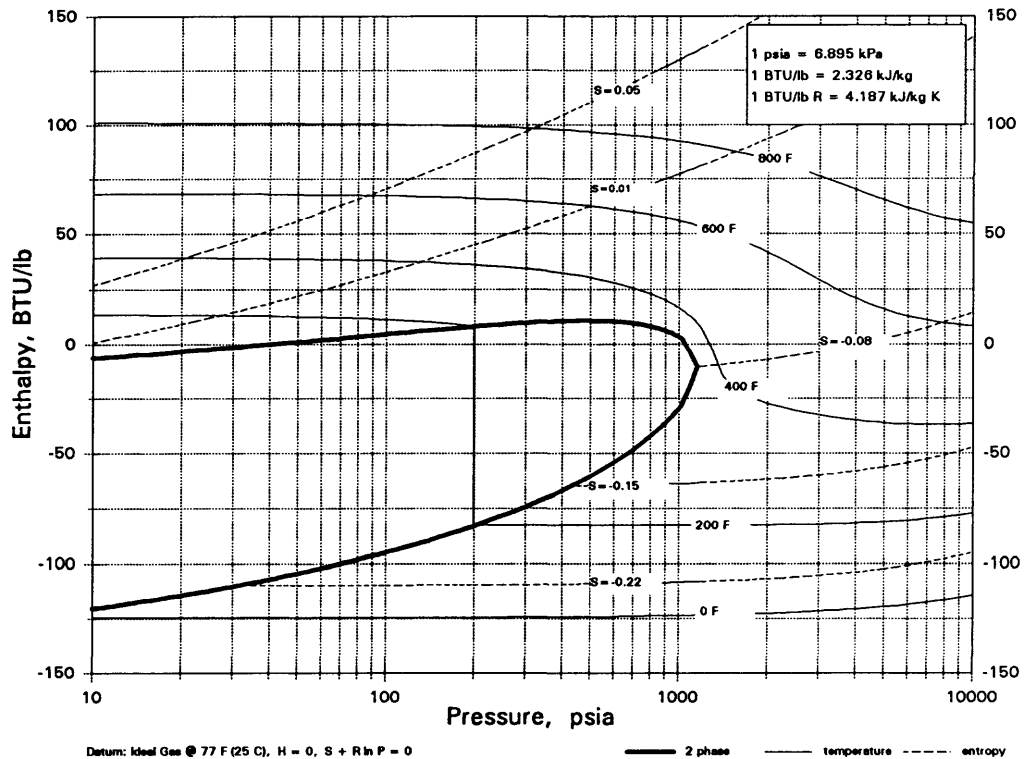
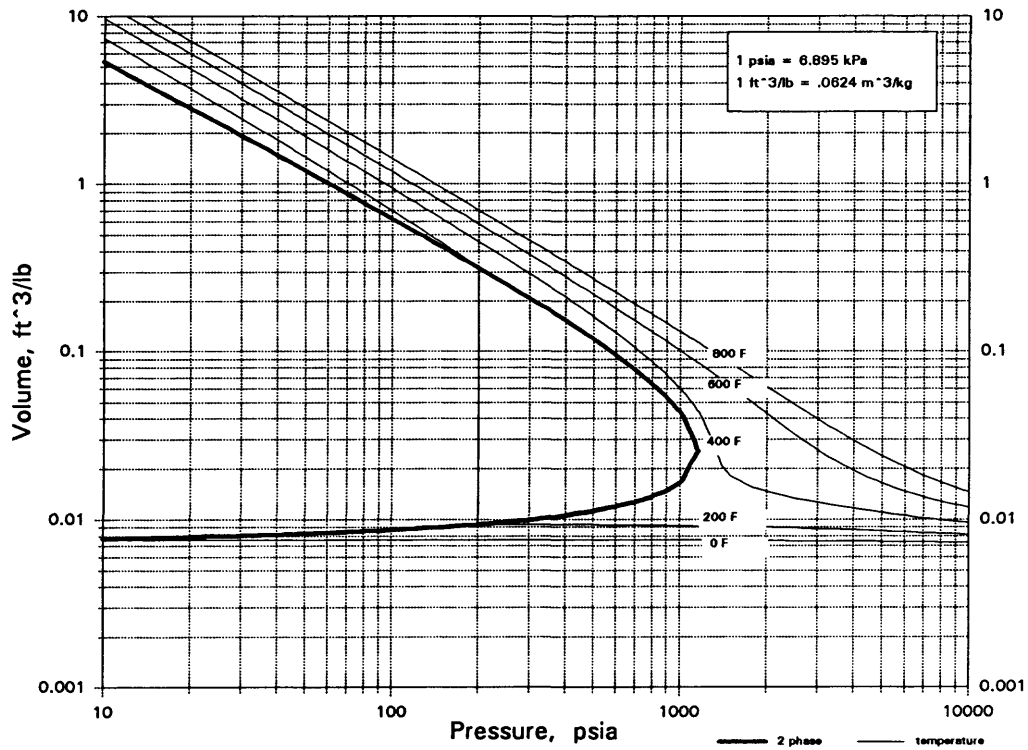


CH2O2

FORMIC ACID

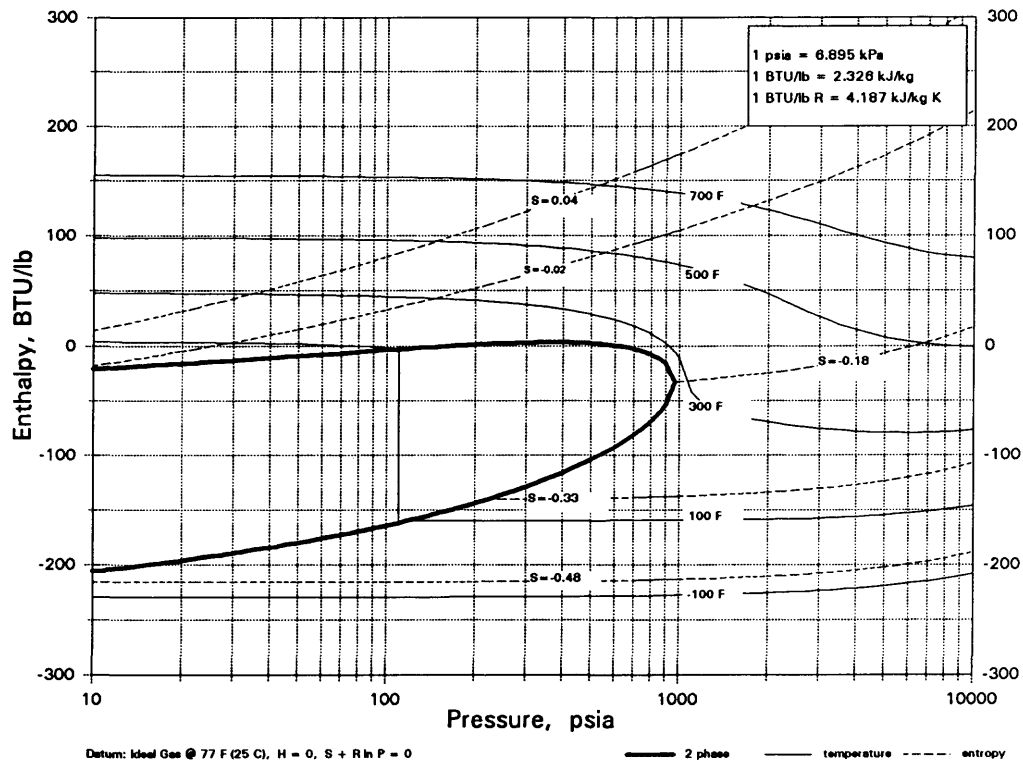
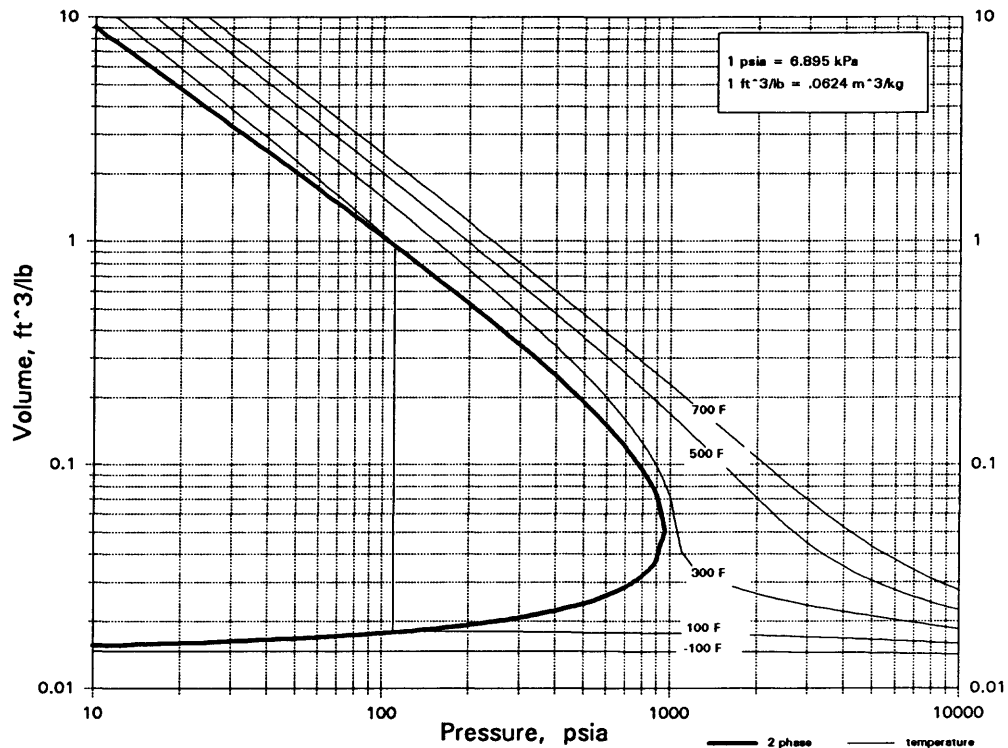


CH₃Br
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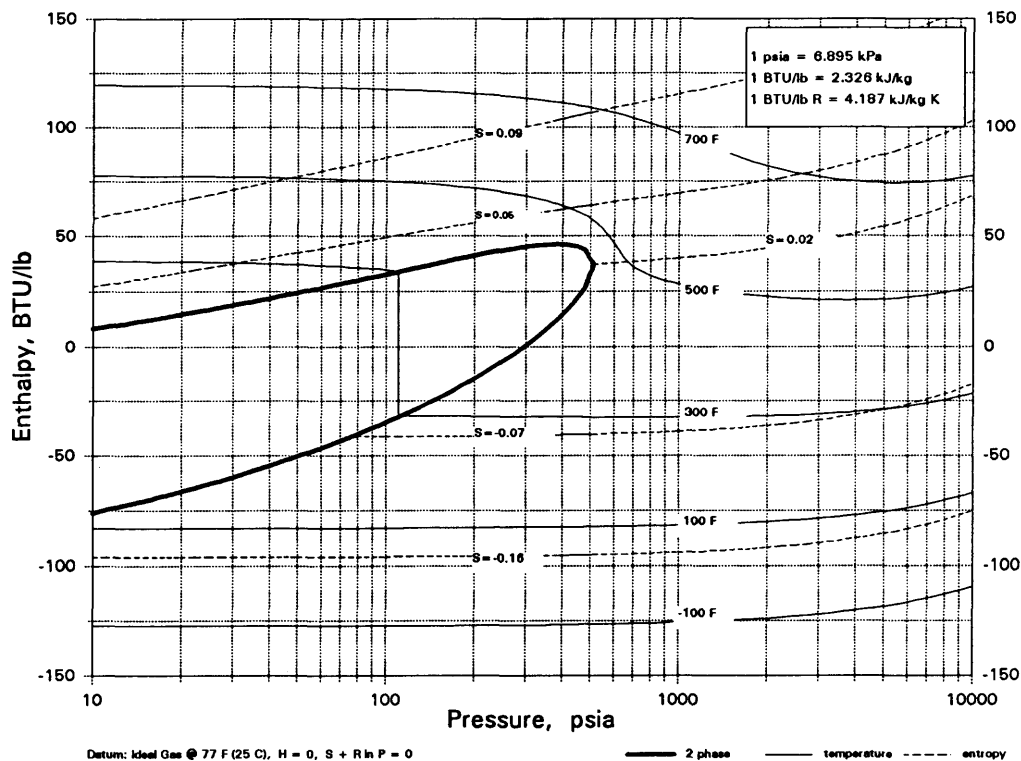
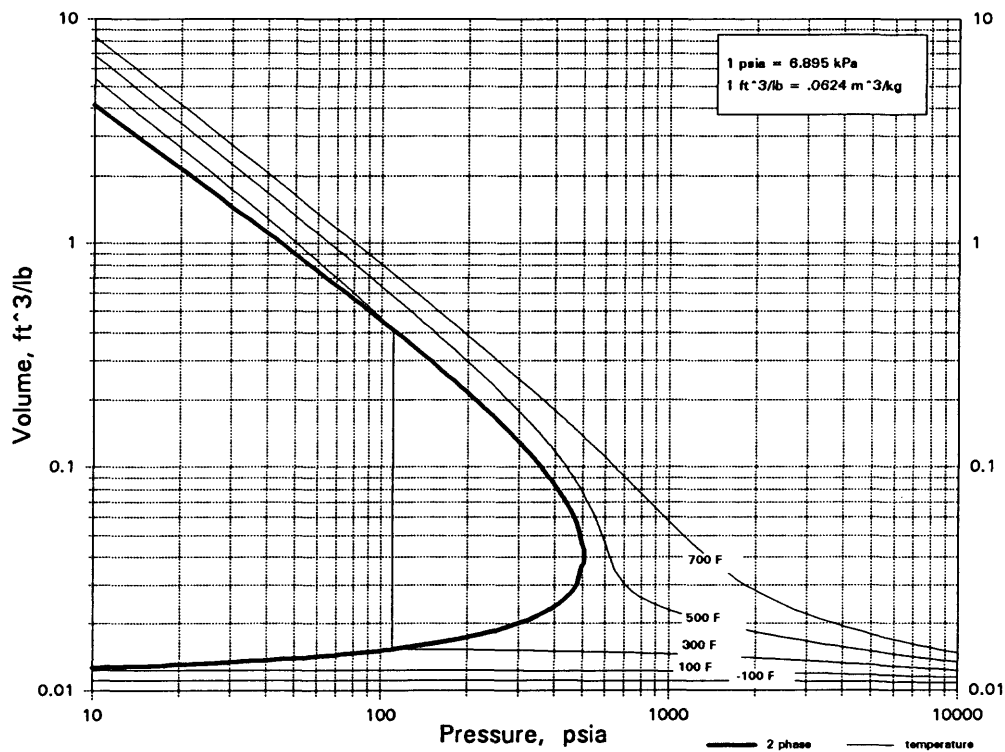
CH₃Cl

METHYL CHLORIDE



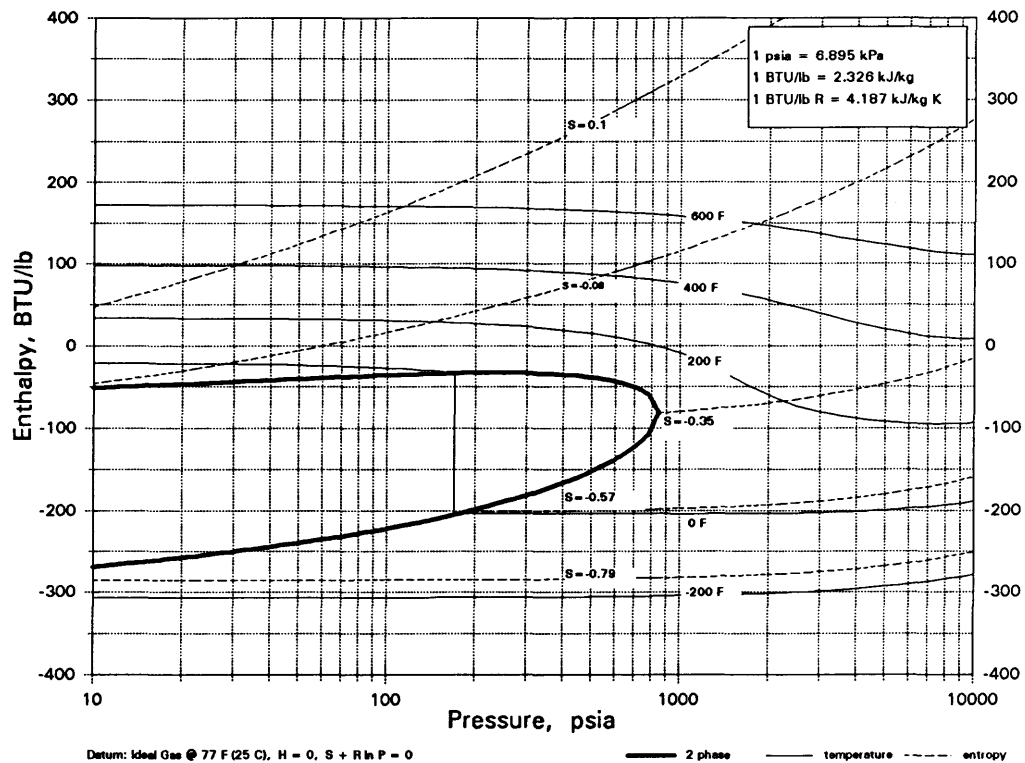
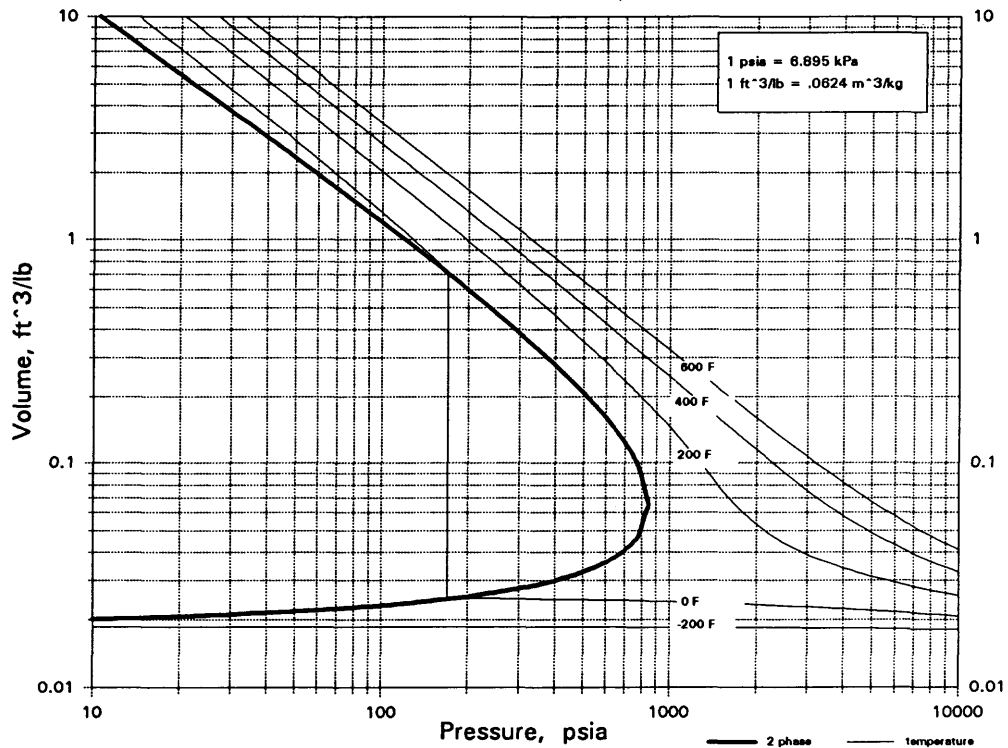


METHYL TRICHLOROSILANE

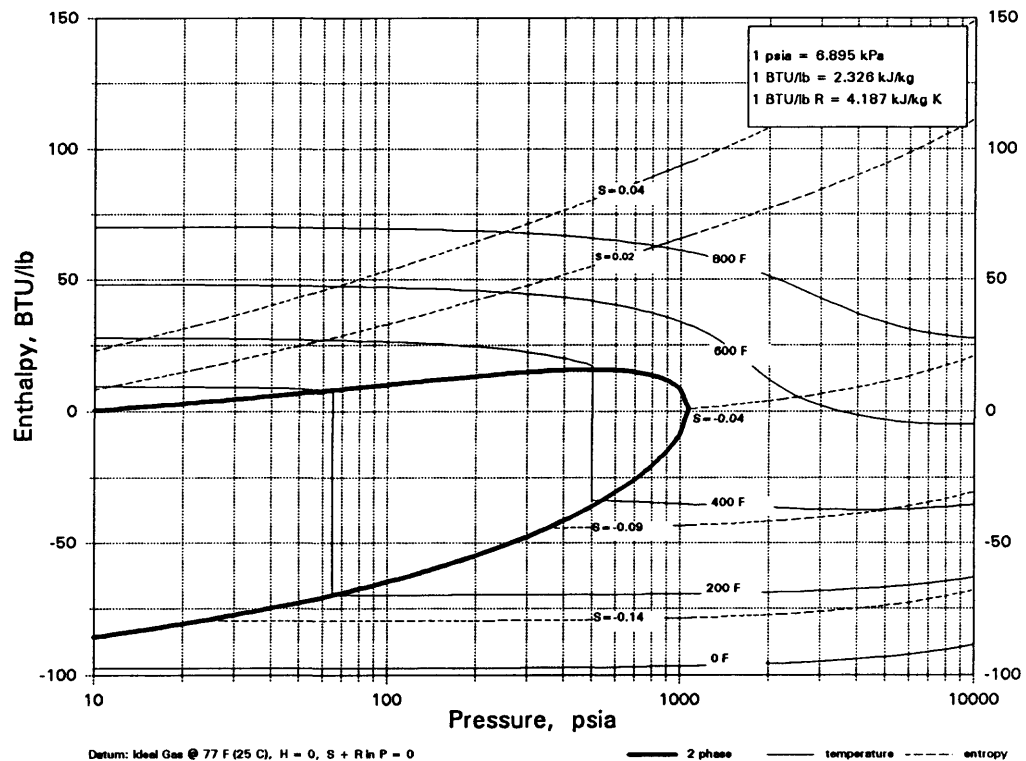
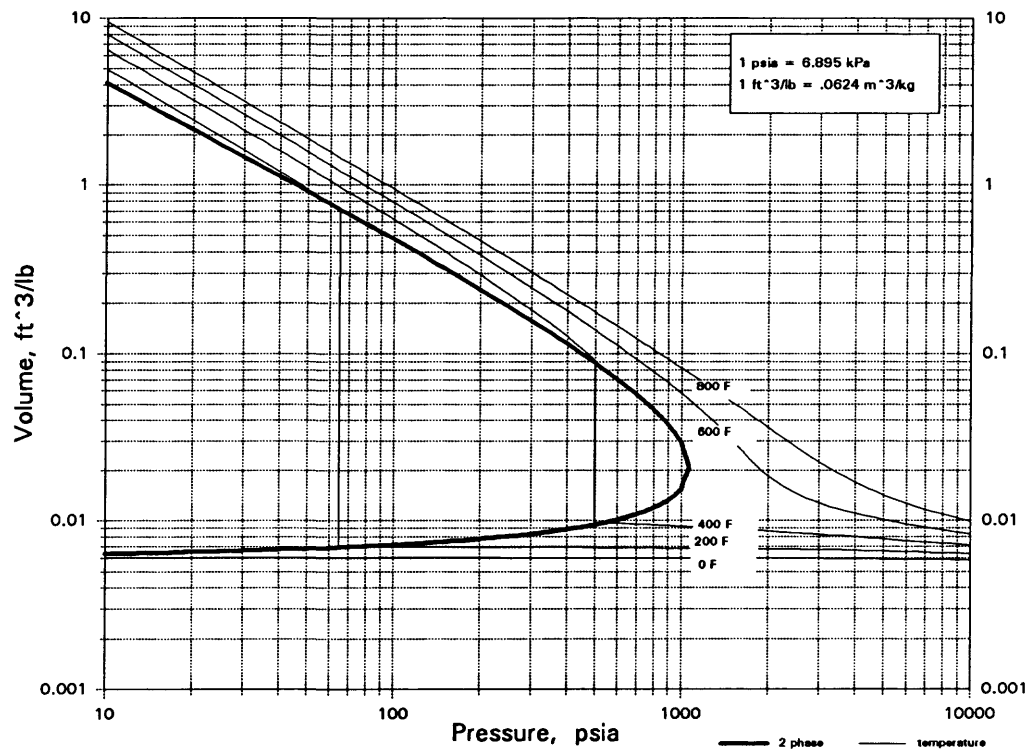


CH3F

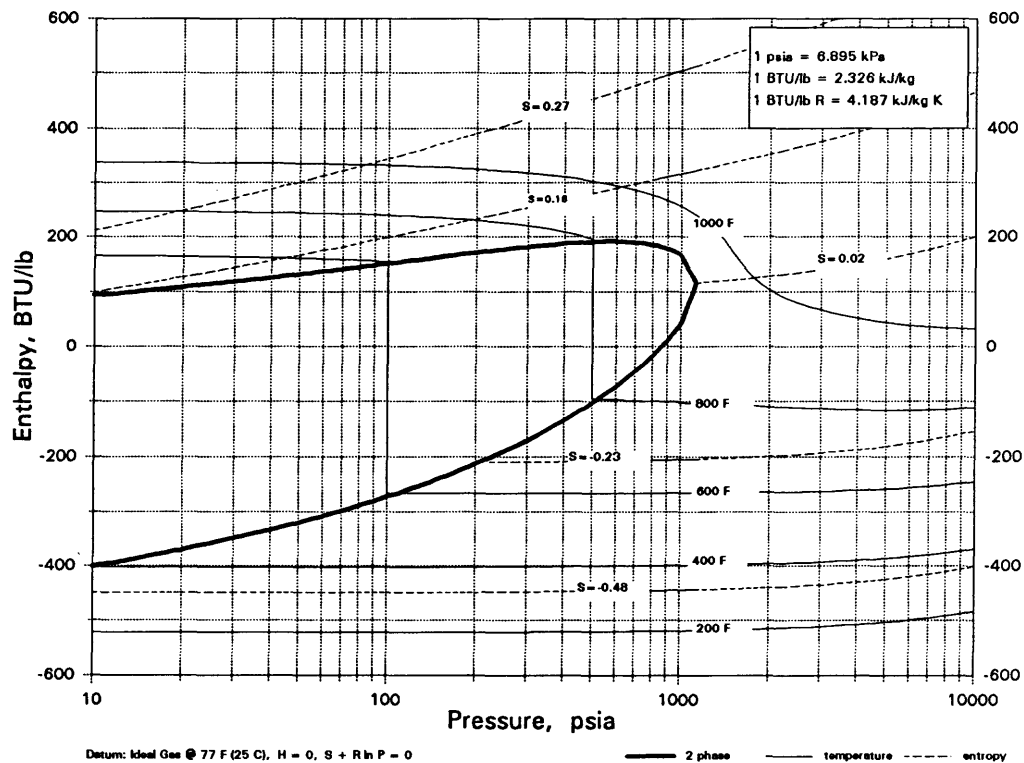
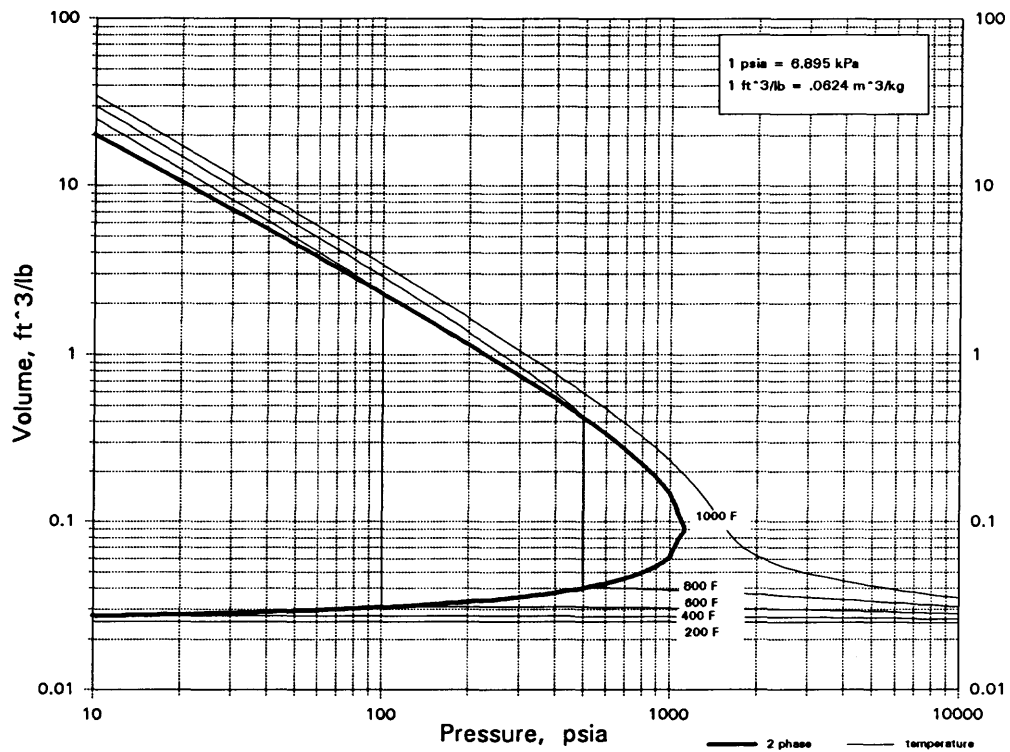
METHYL FLUORIDE



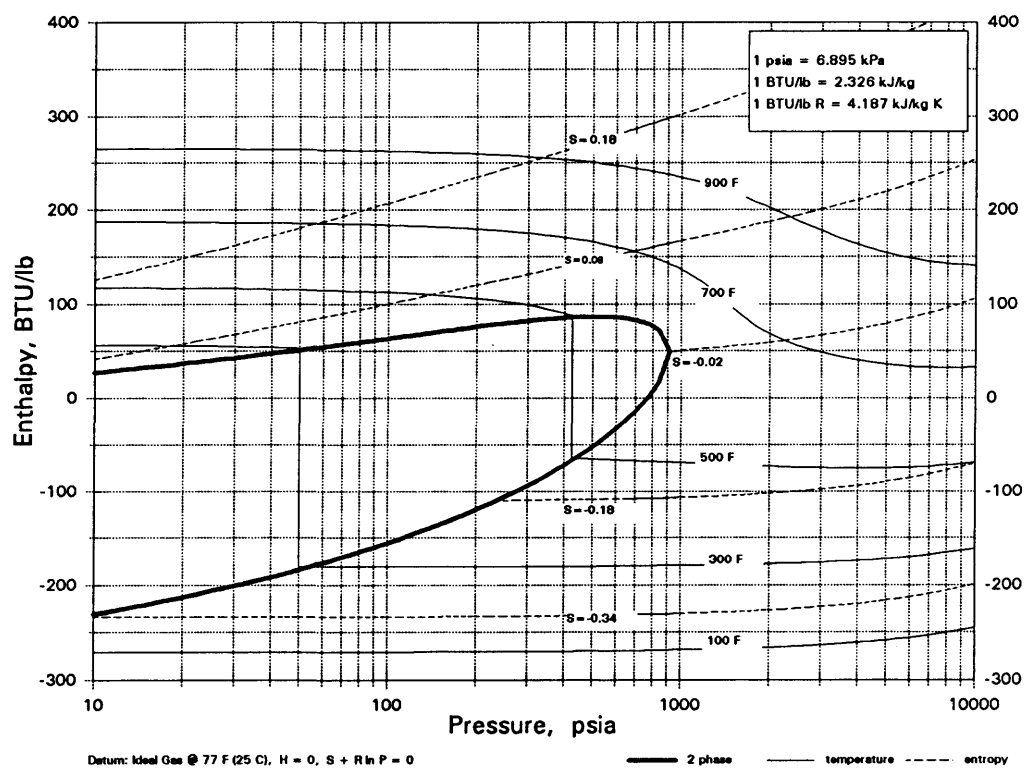
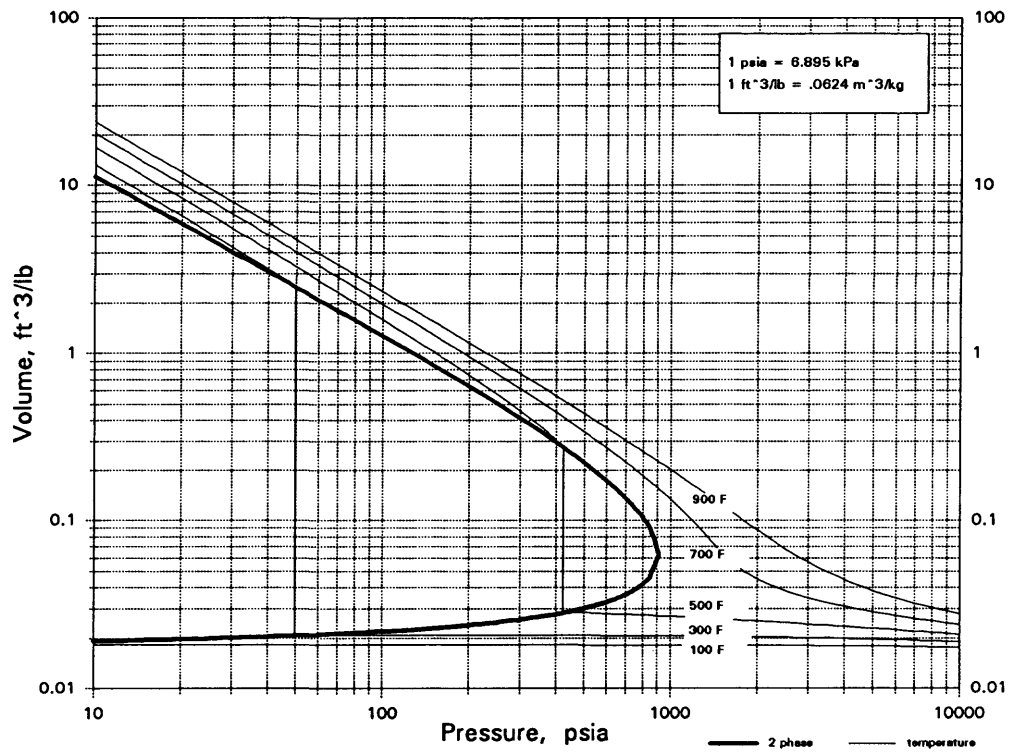
CH₃I
METHYL IODIDE



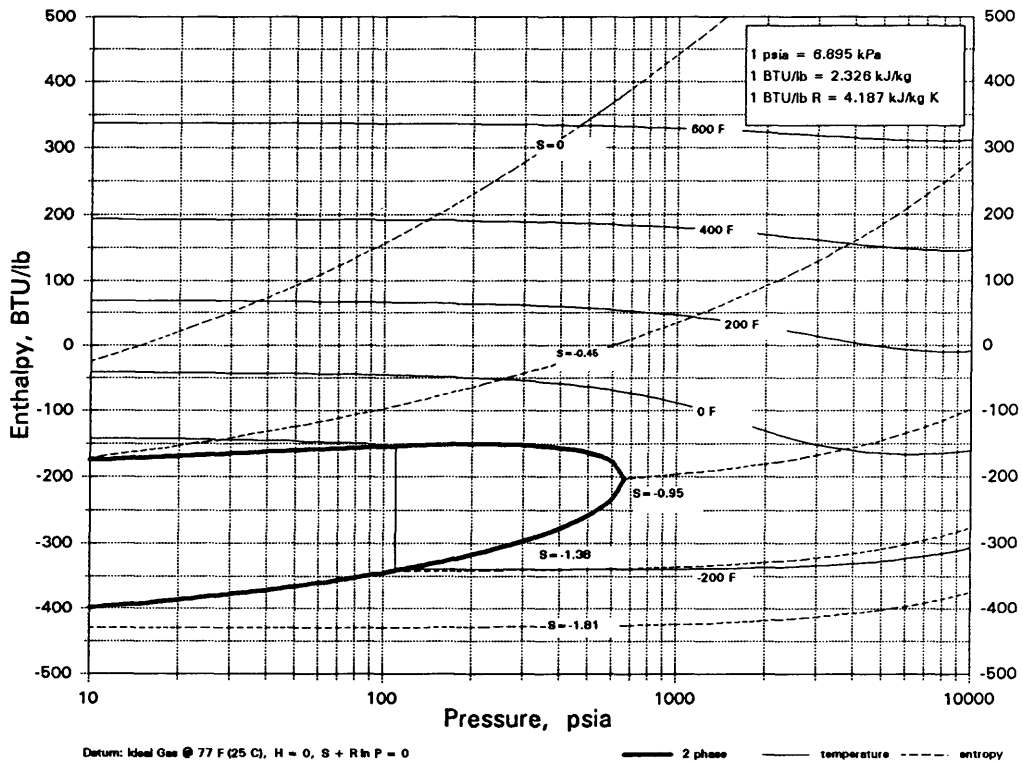
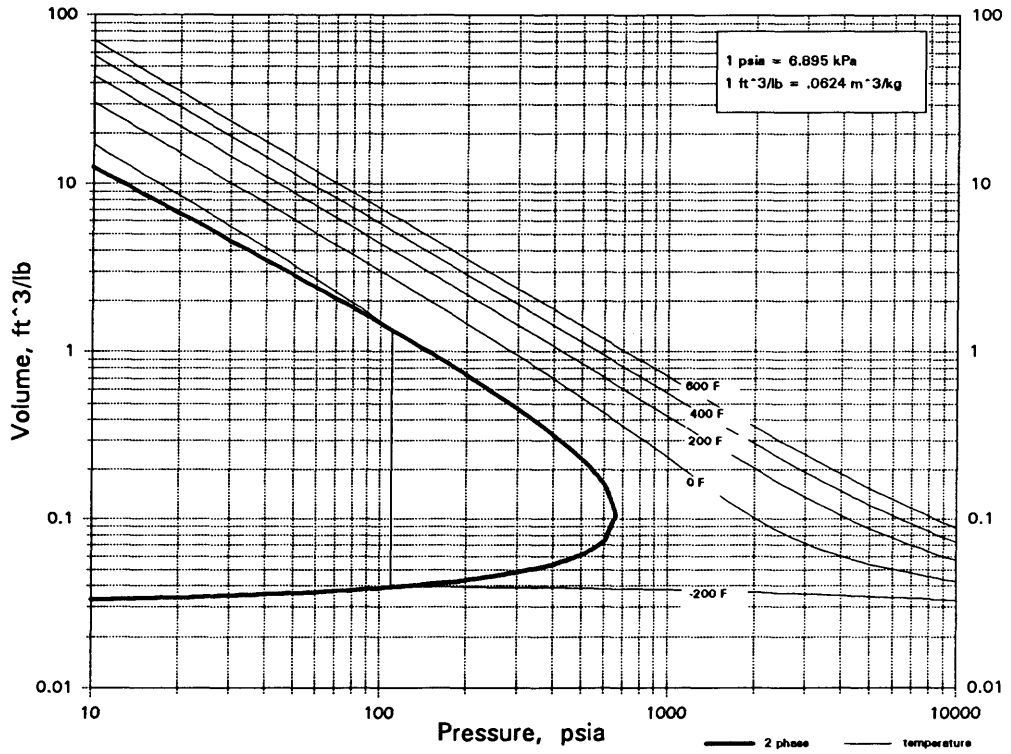
CH3NO
FORMAMIDE



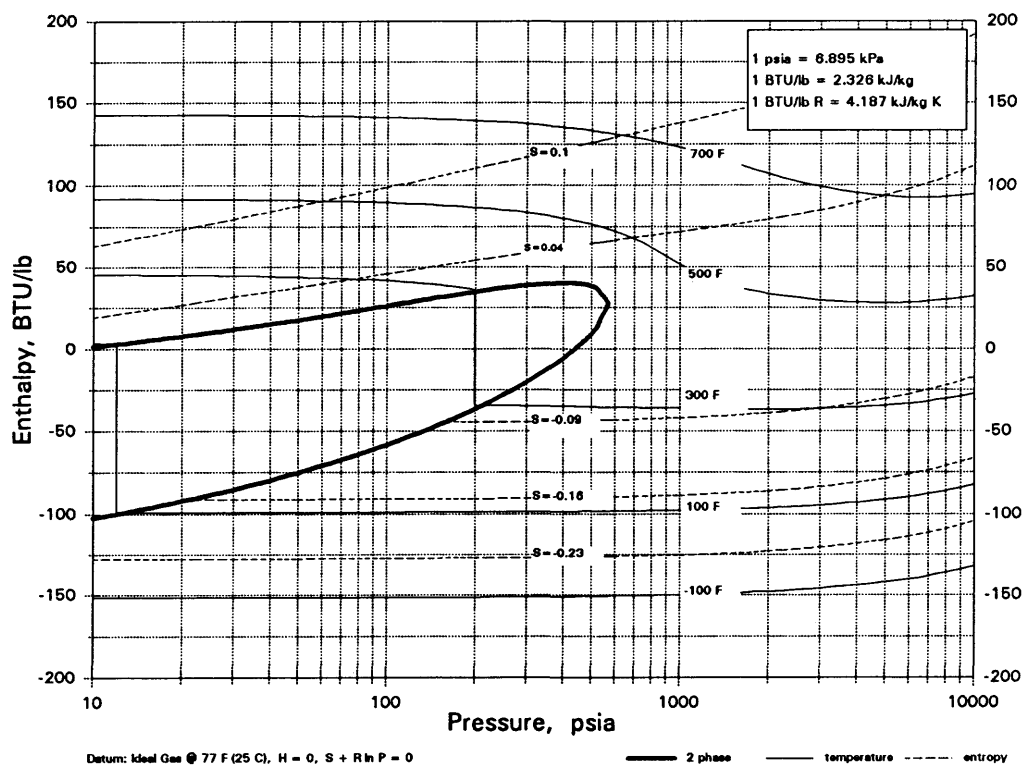
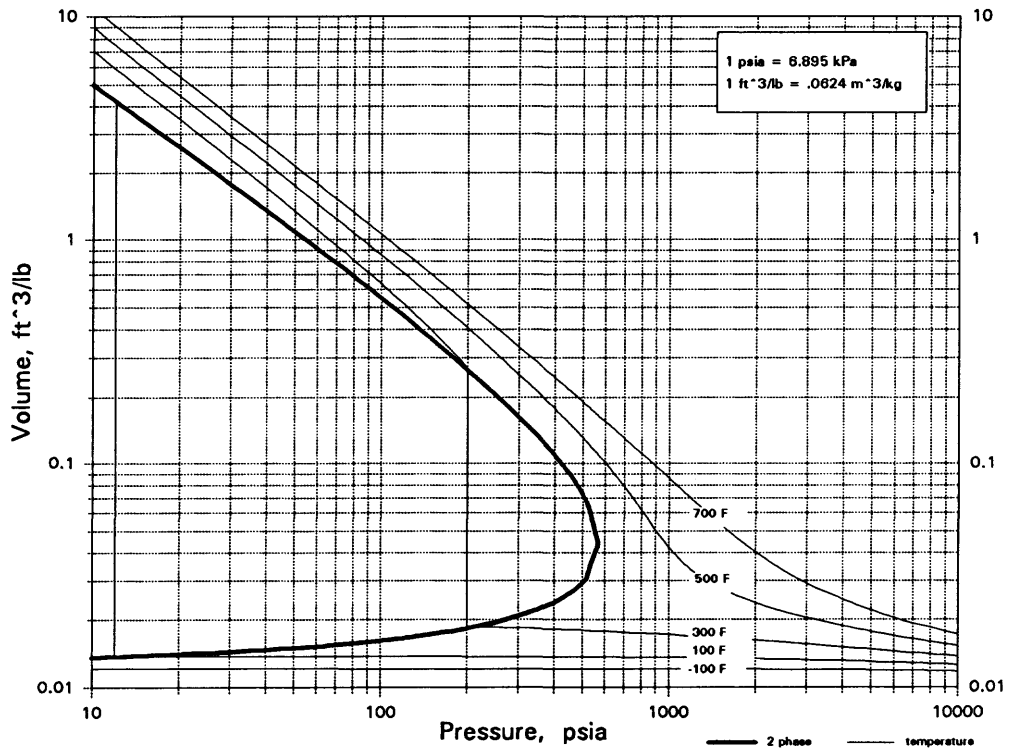
CH₃NO₂
NITROMETHANE



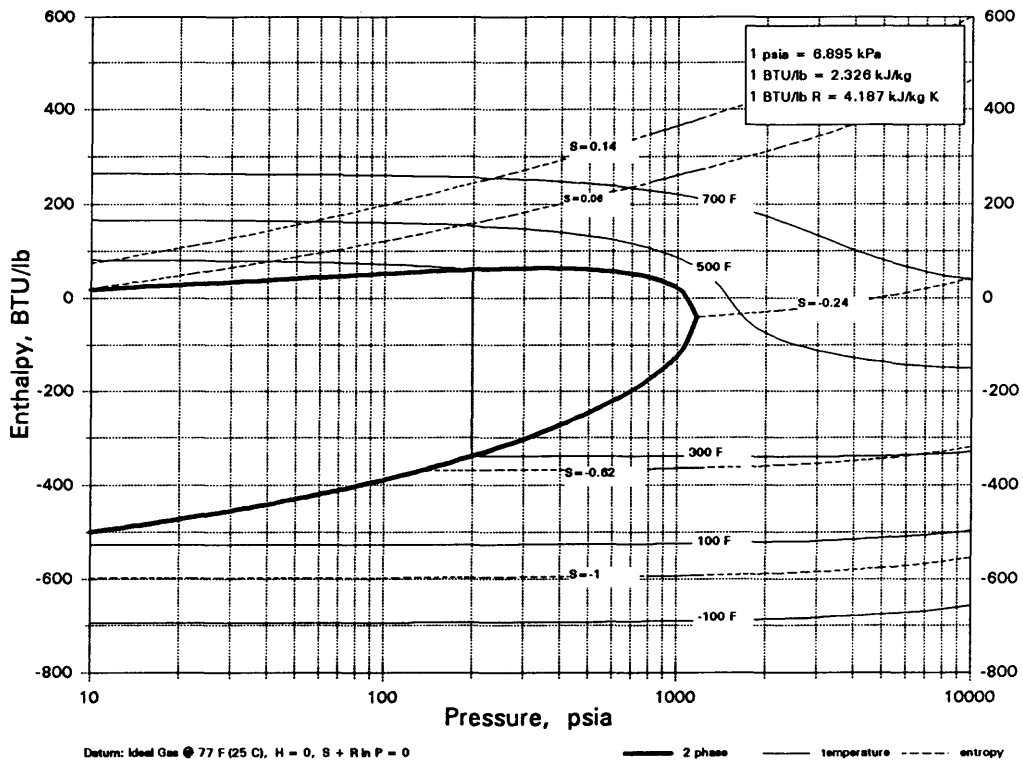
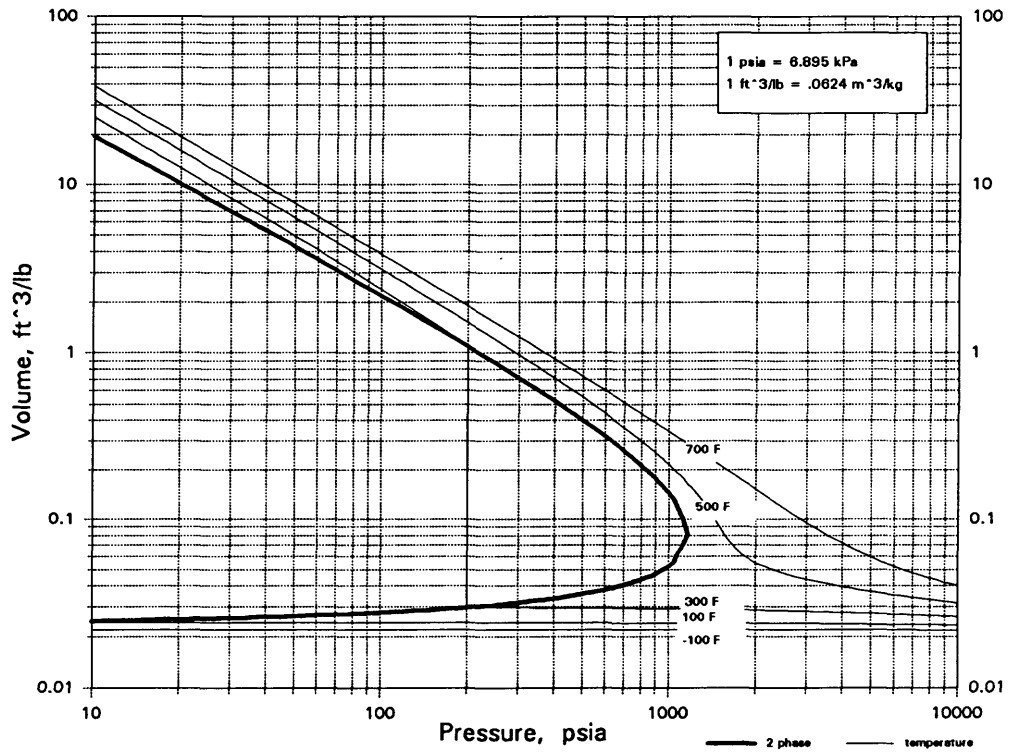
CH₄
METHANE



CH₄Cl₂Si
METHYL DICHLOROSILANE



CH4O
METHANOL



CH4O3S

METHANESULFONIC ACID

1. Molecular Weight, lb/mol..... 96.107

2. Boiling Point, K..... 561.00

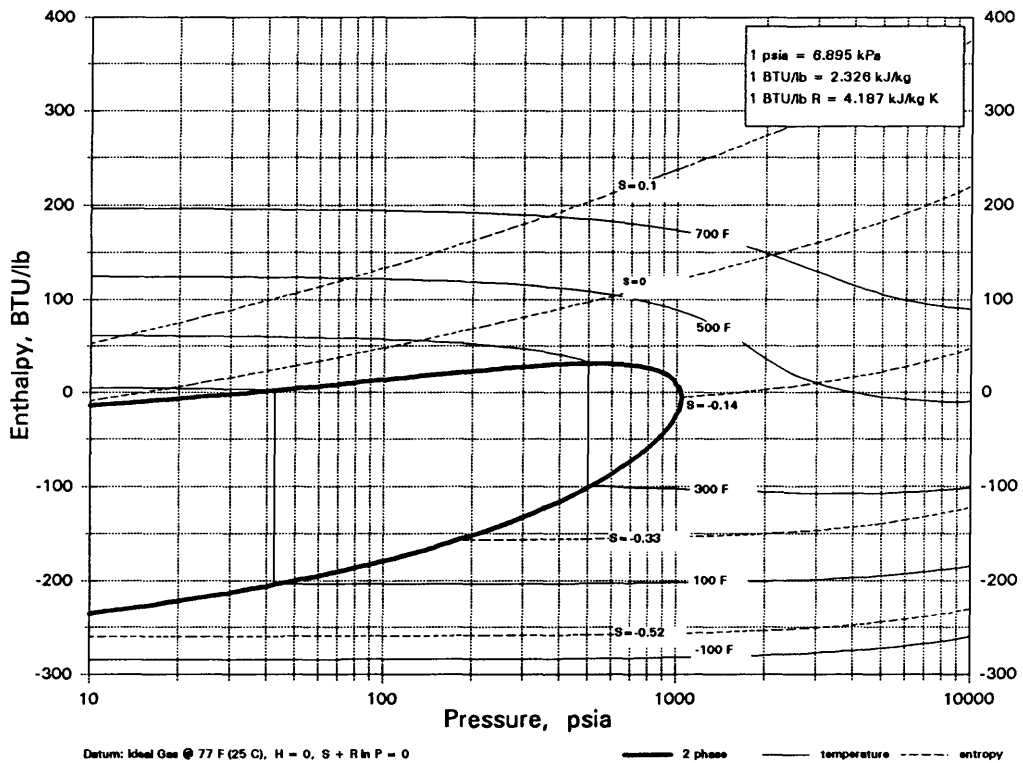
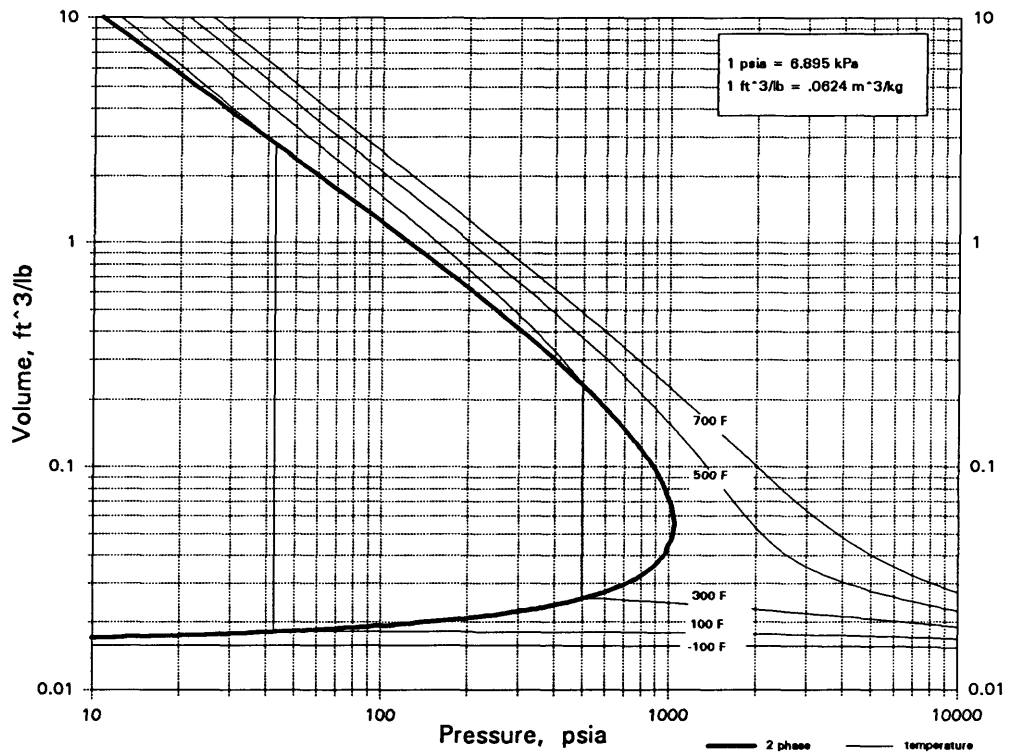
Critical data (Tc, Pc) are not available.

1. Molecular Weight, lb/mol..... 96.107

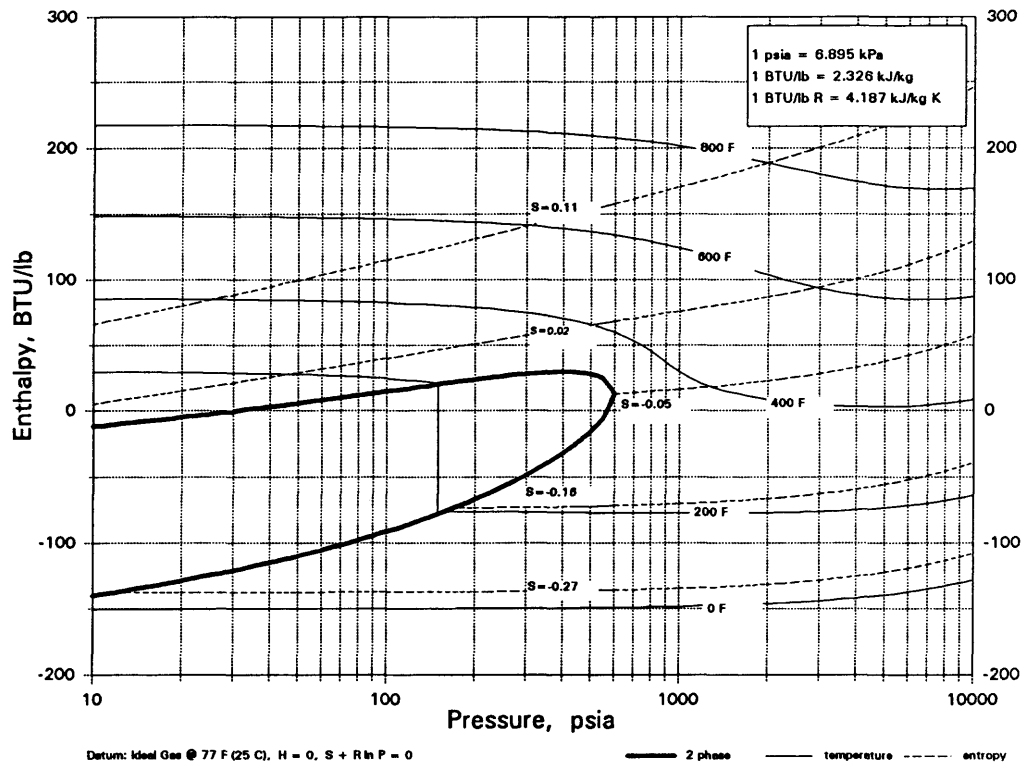
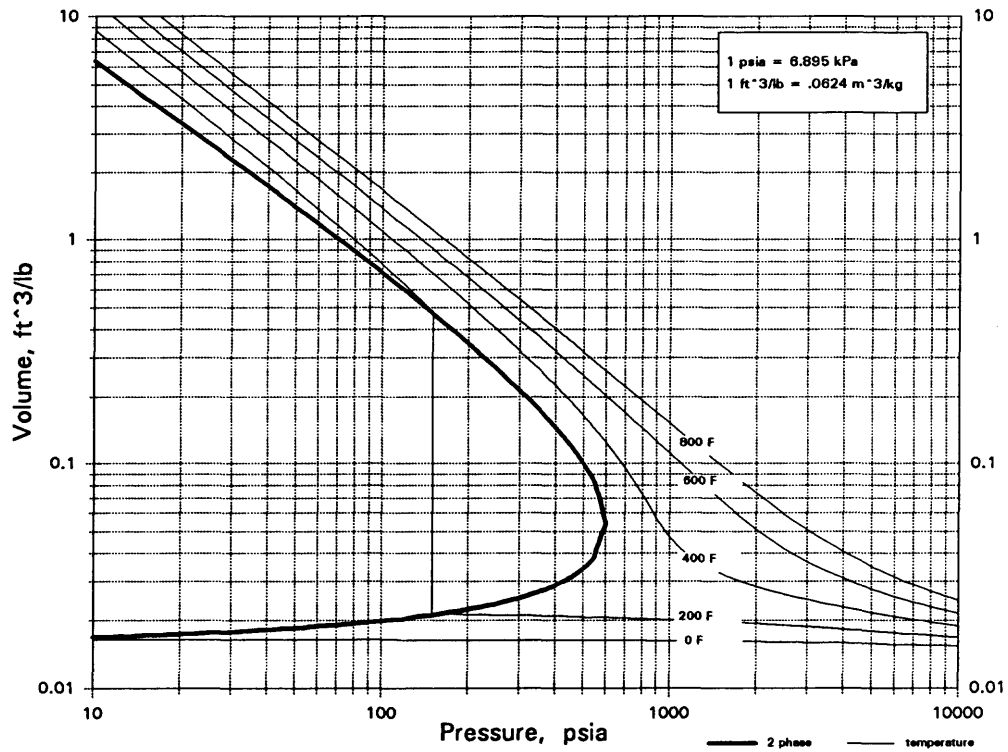
2. Boiling Point, K..... 561.00

Critical data (Tc, Pc) are not available.

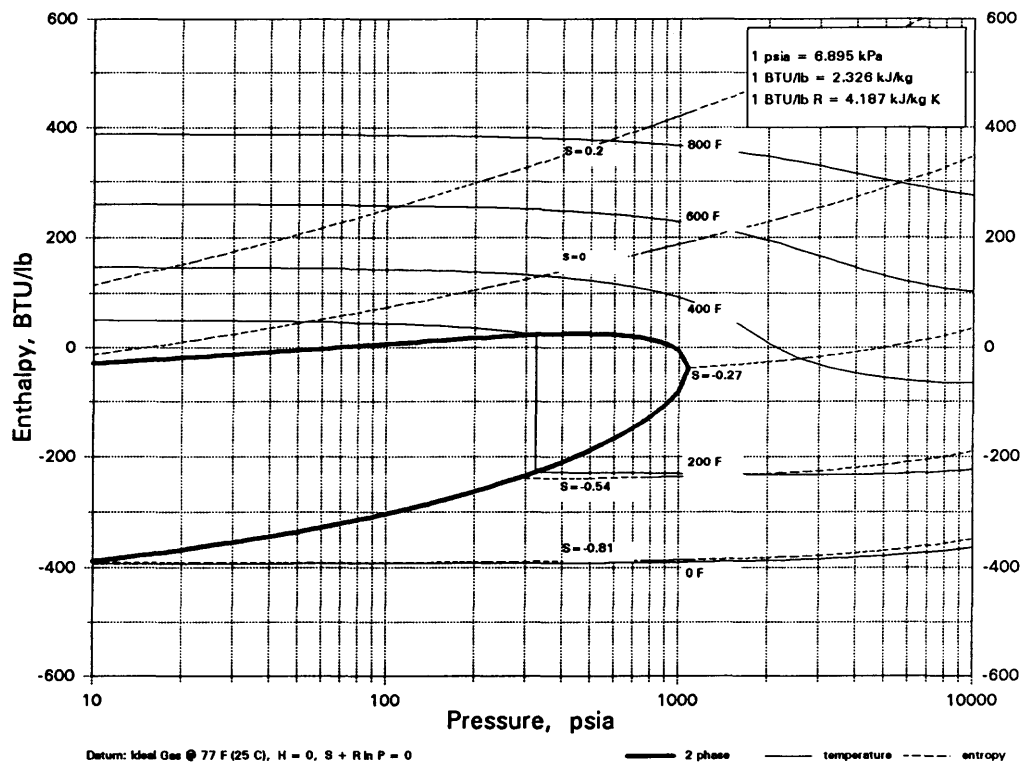
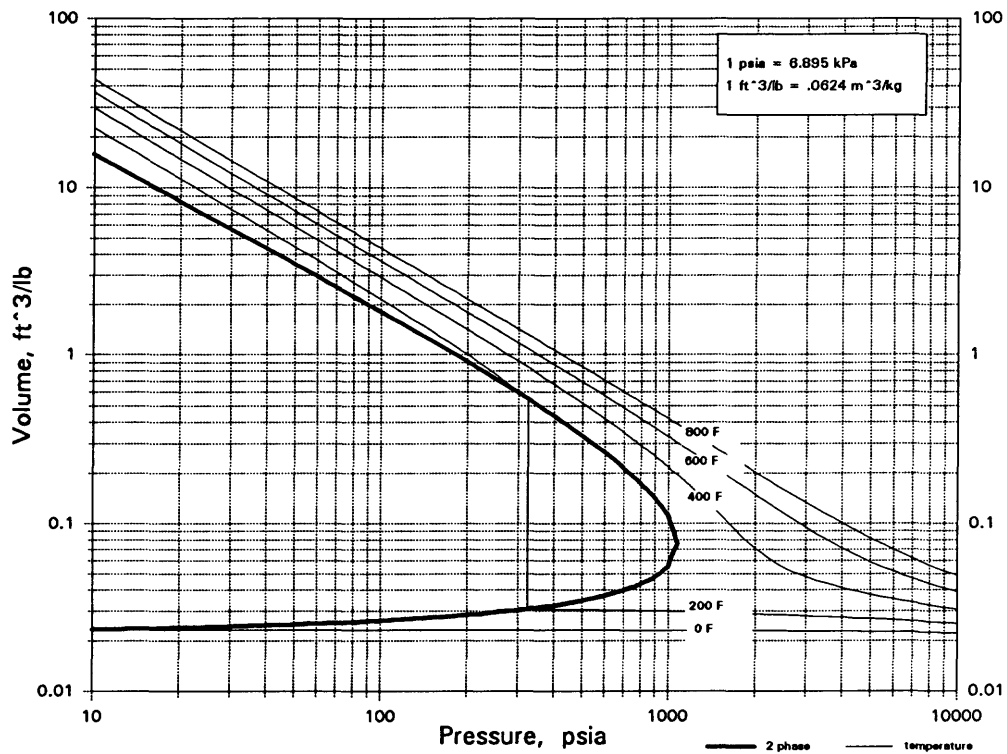
CH4S
METHYL MERCAPTAN



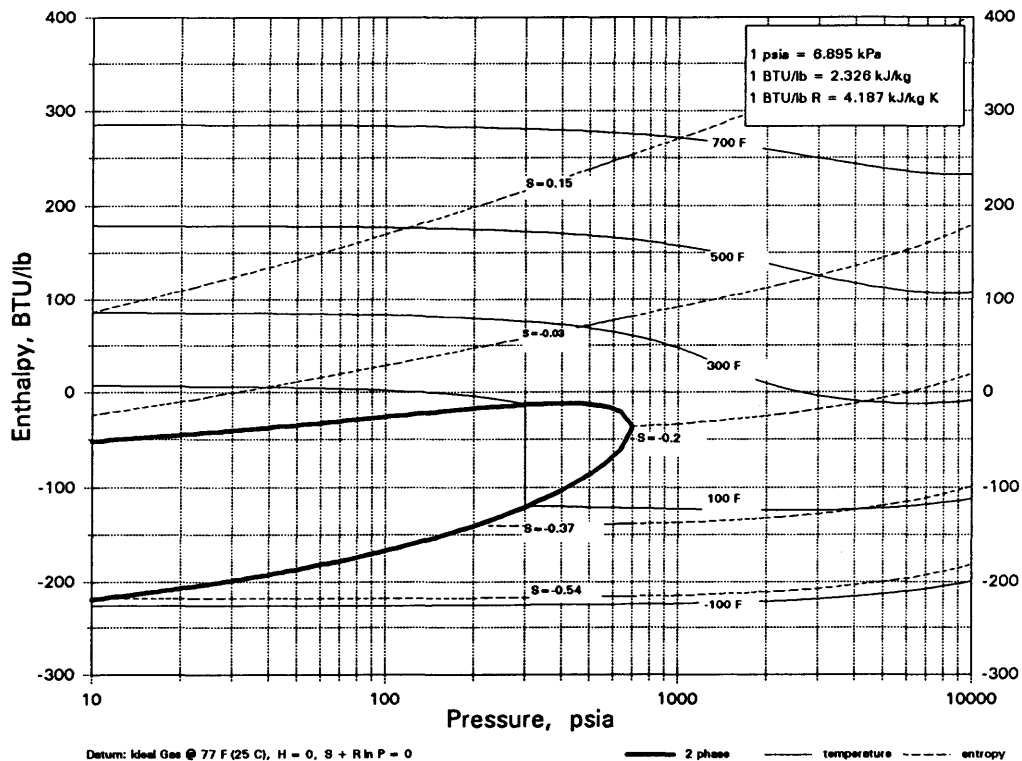
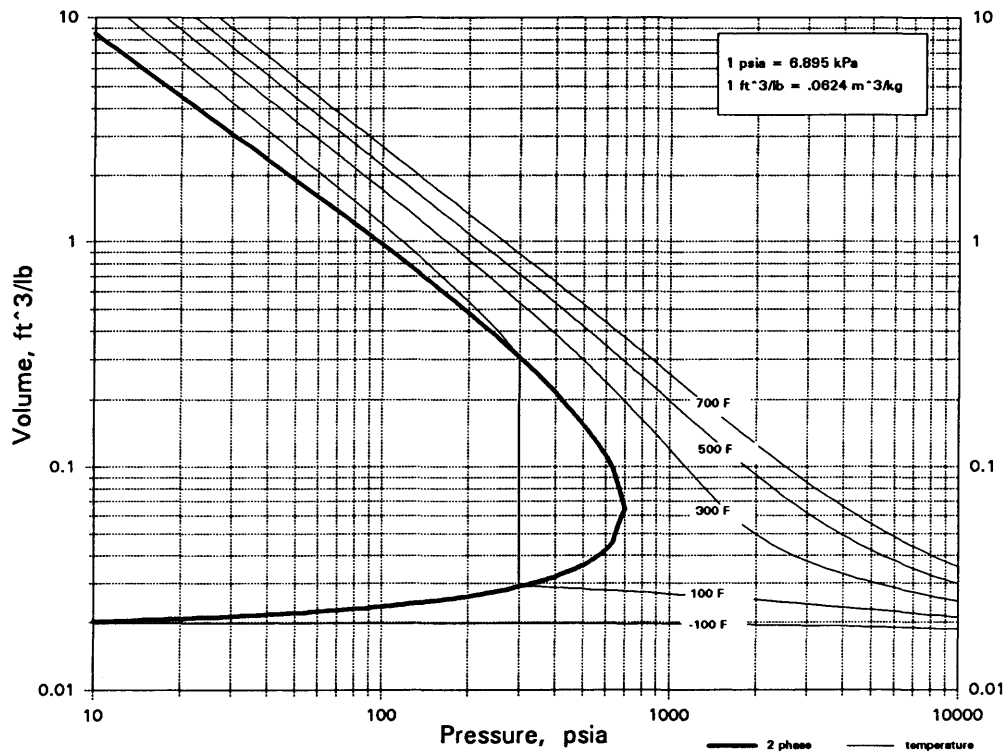
CH₅ClSi
METHYL CHLOROSILANE



CH5N
METHYLAMINE

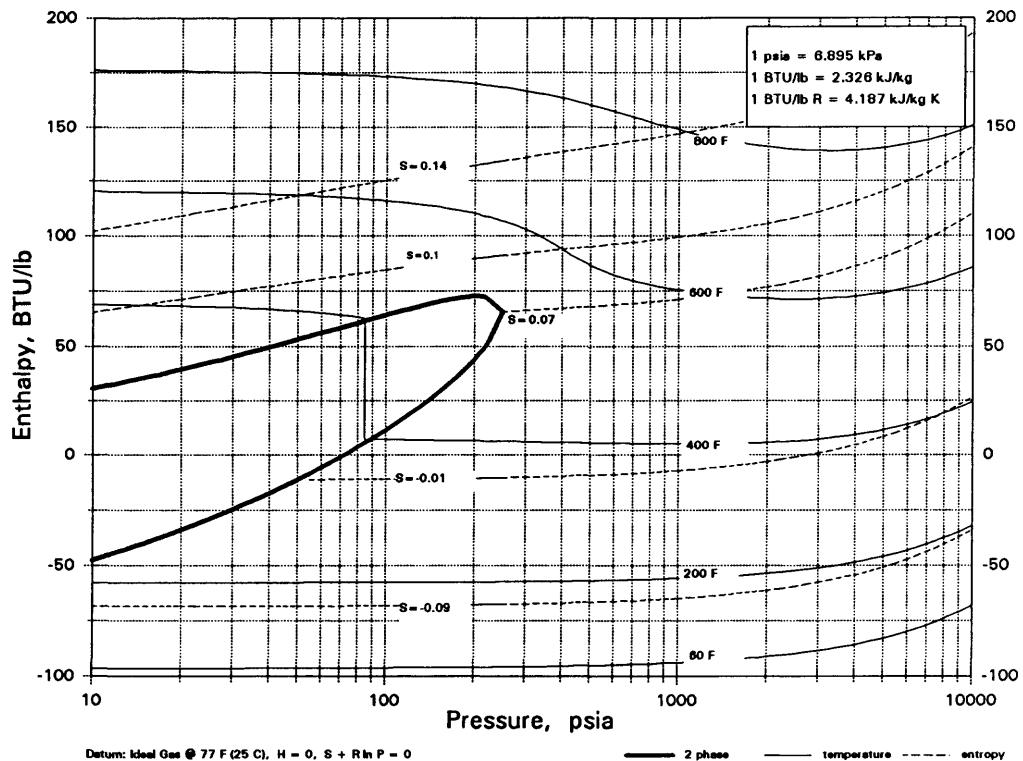
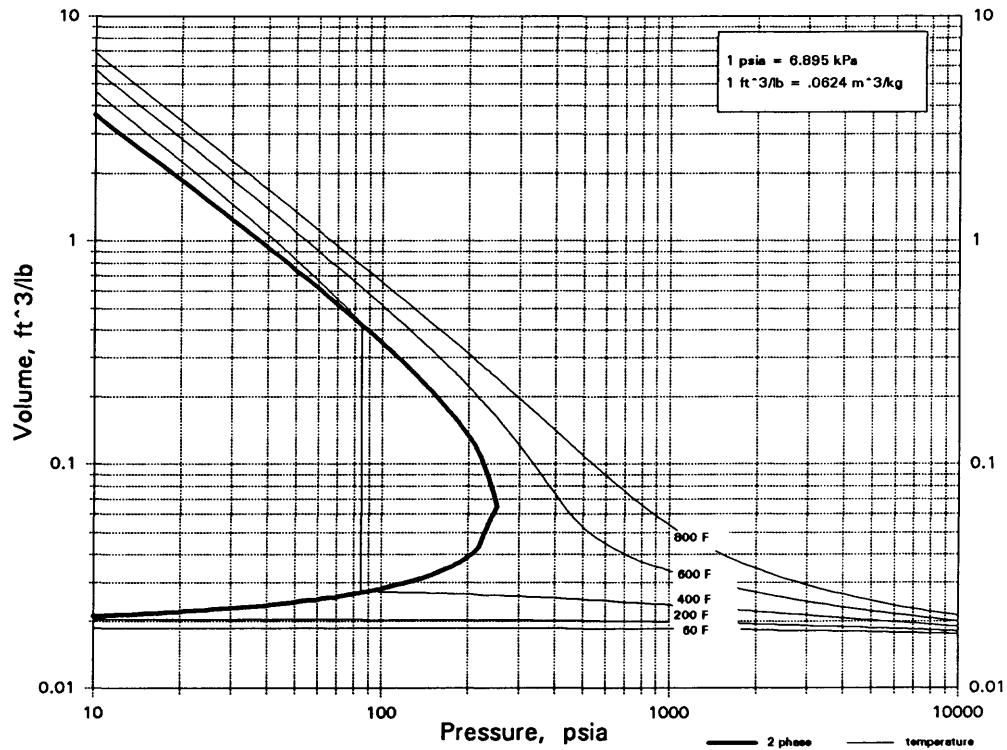


CH₆Si
METHYL SILANE

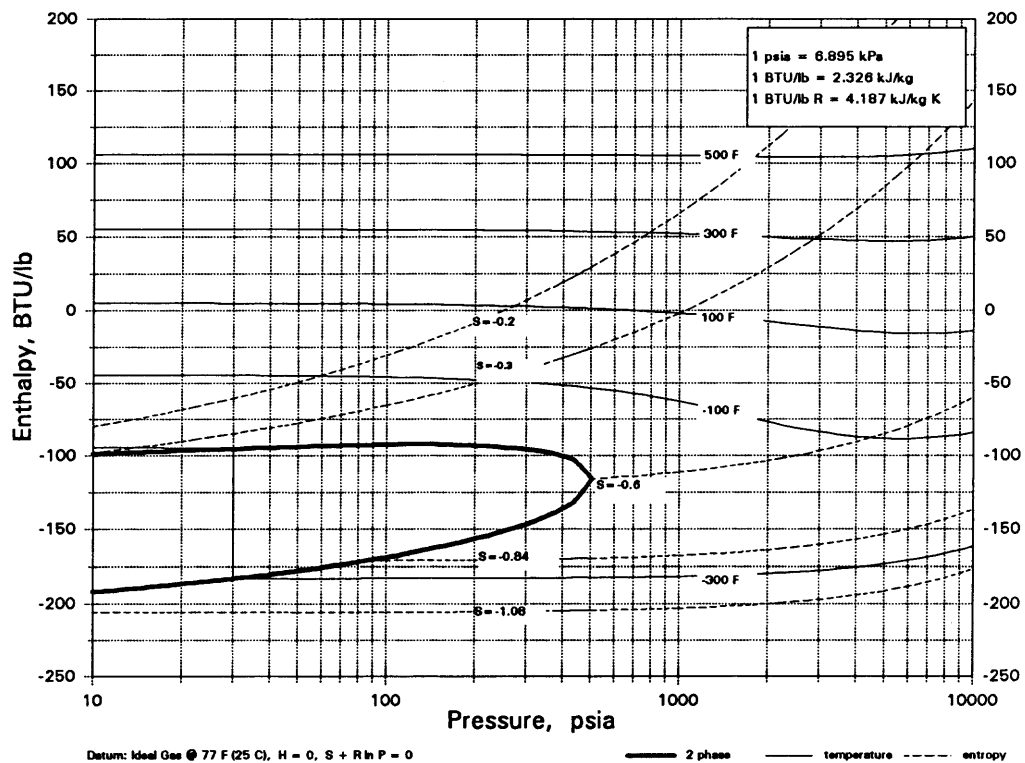
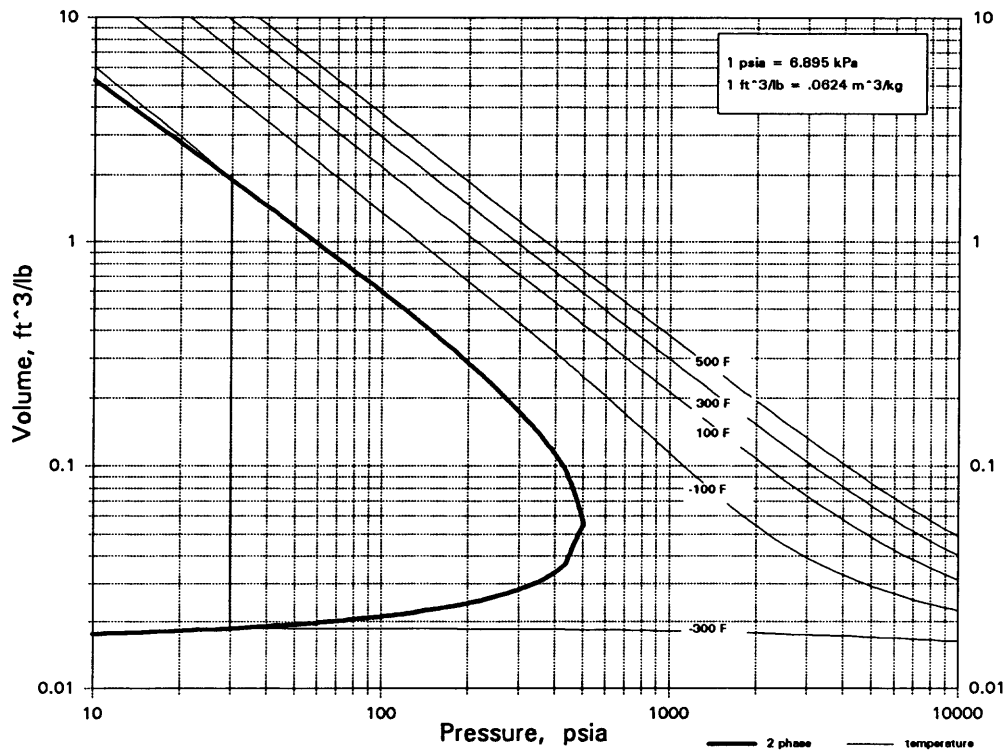


CN408

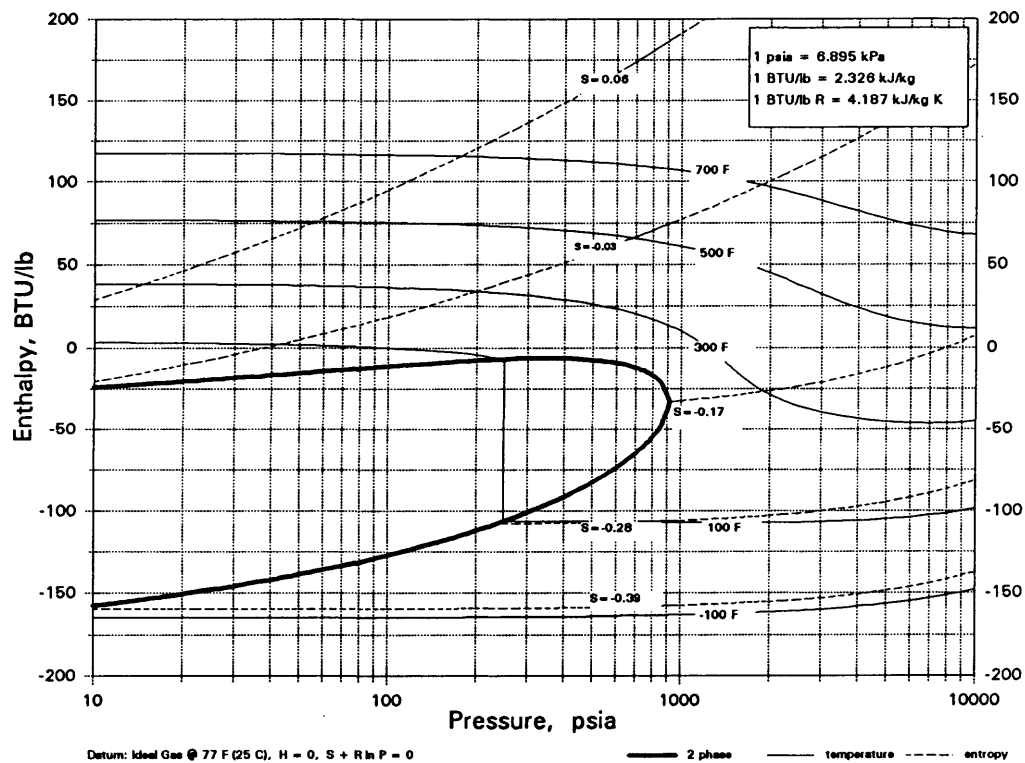
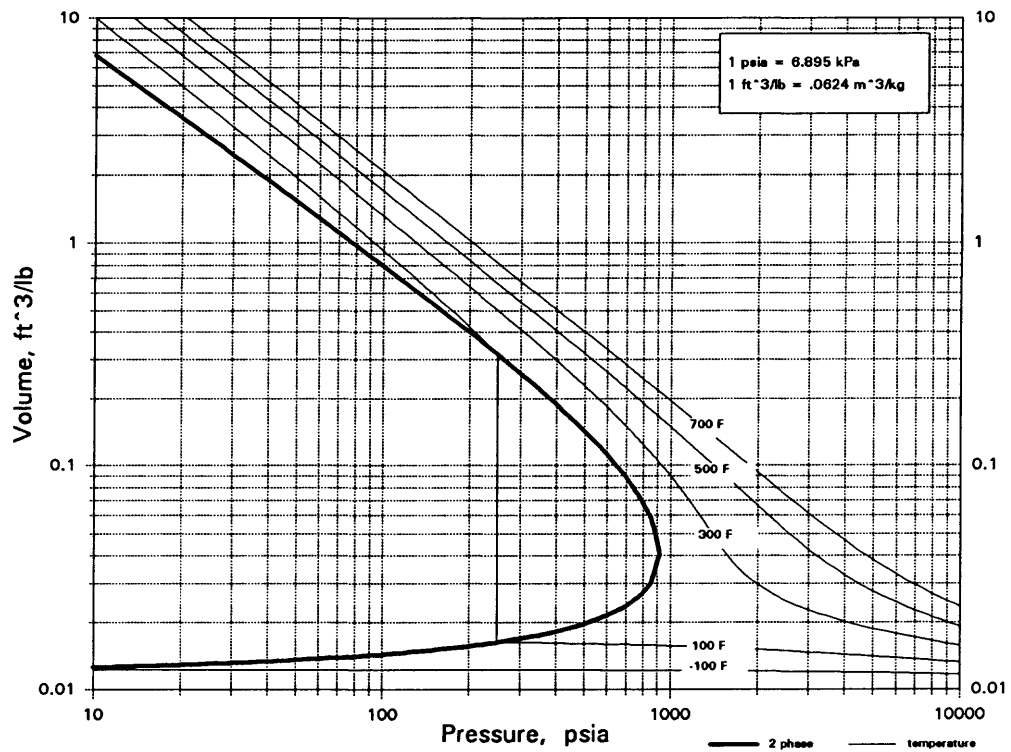
TETRANITROMETHANE



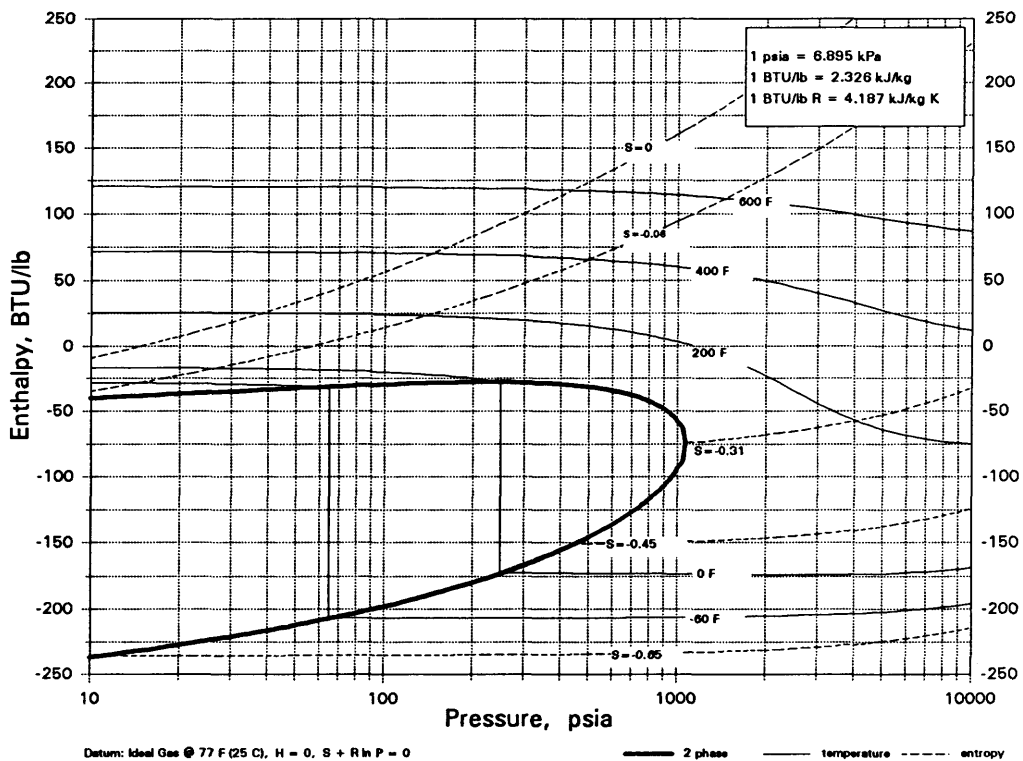
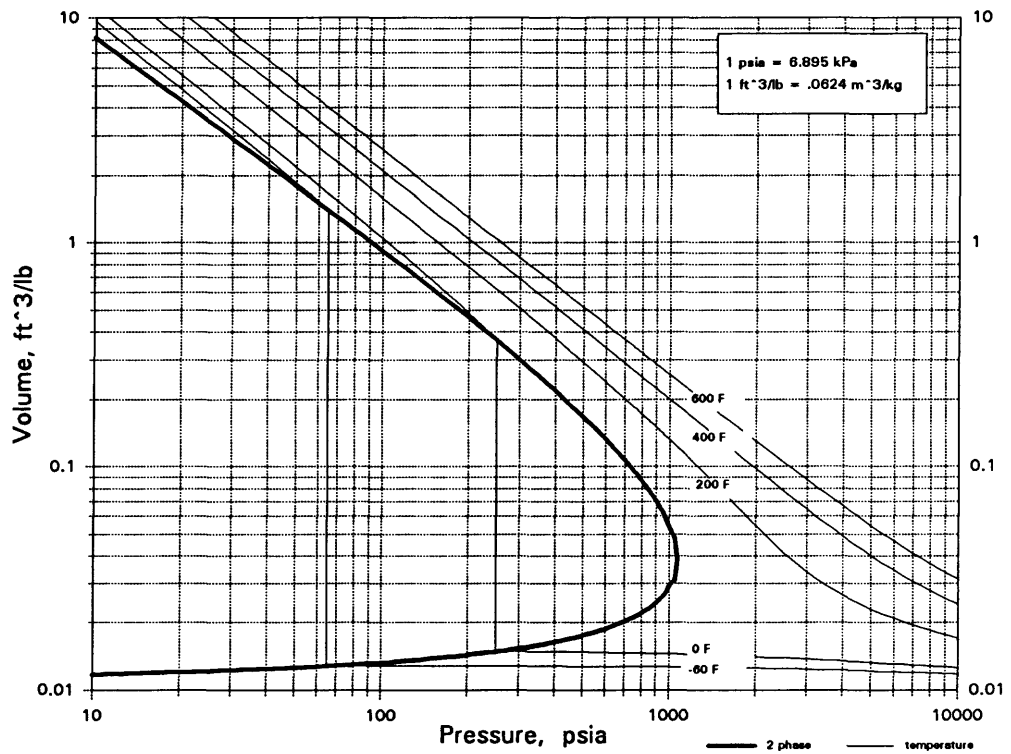
CO
CARBON MONOXIDE



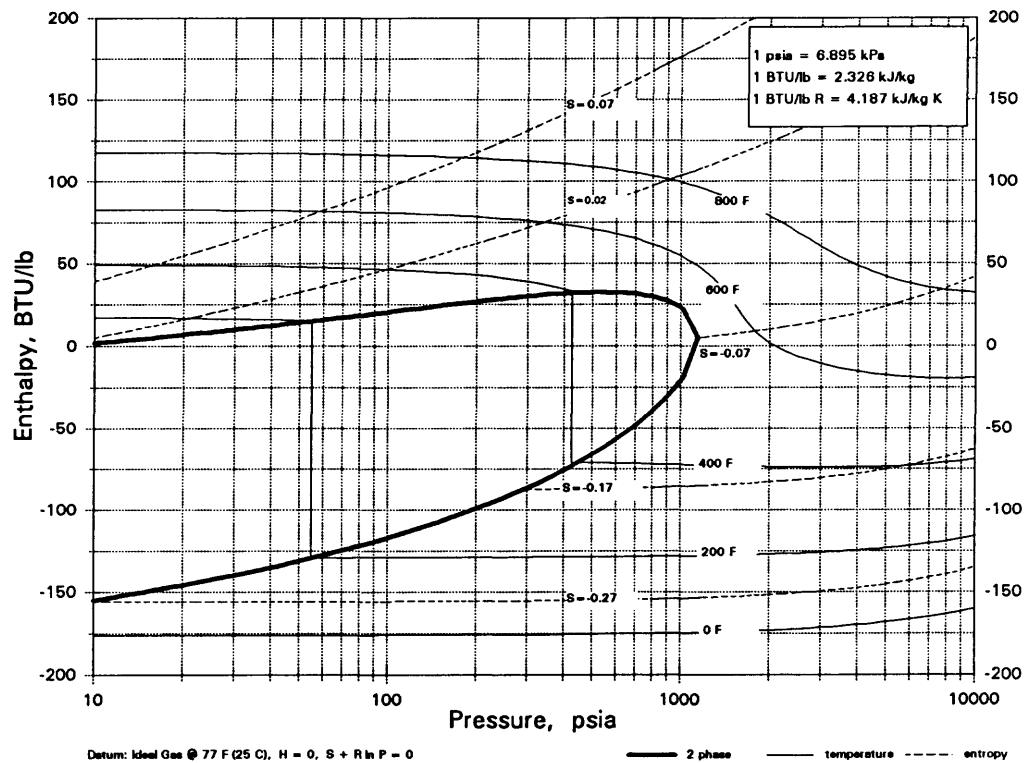
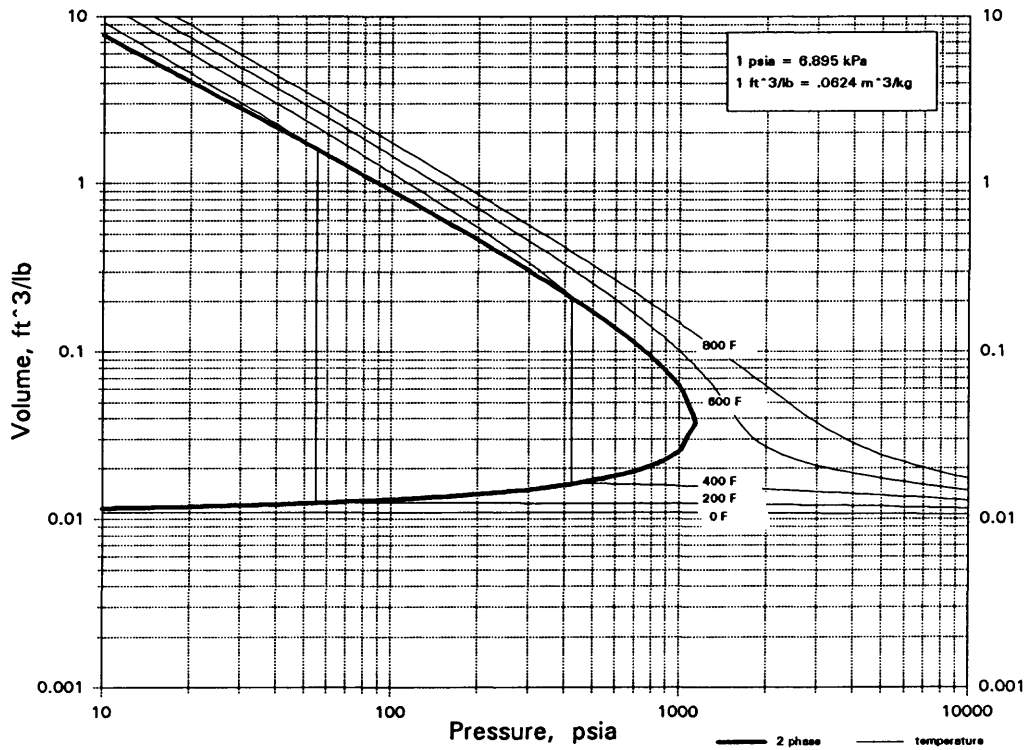
COS
CARBONYL SULFIDE



CO2
CARBON DIOXIDE

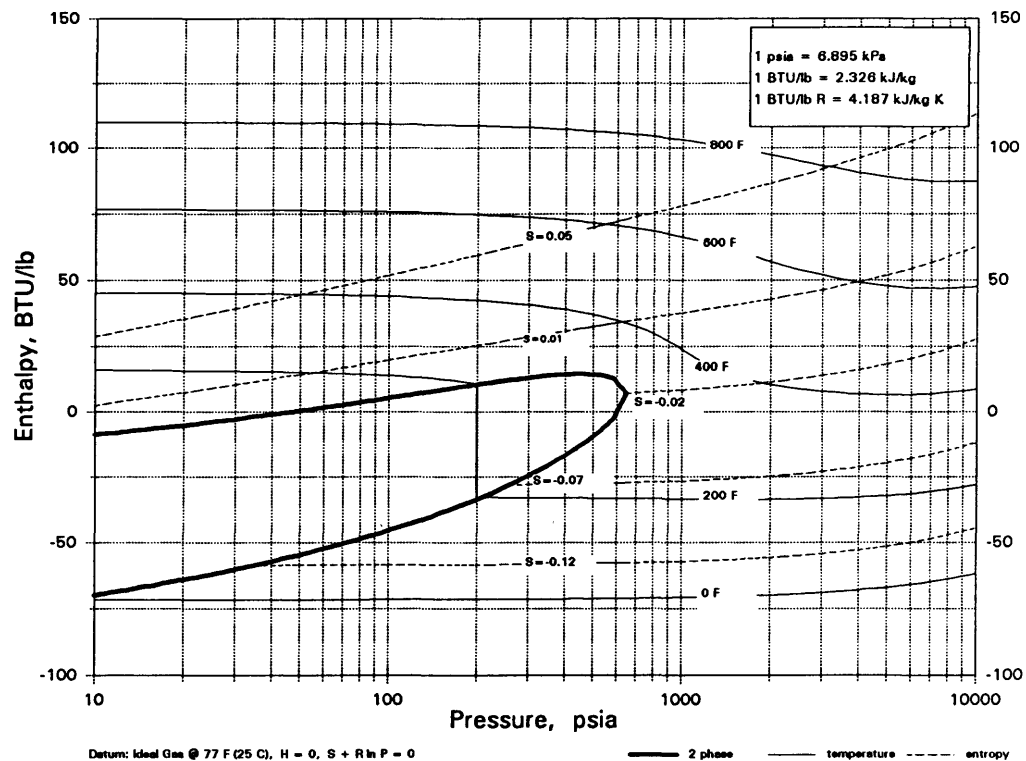
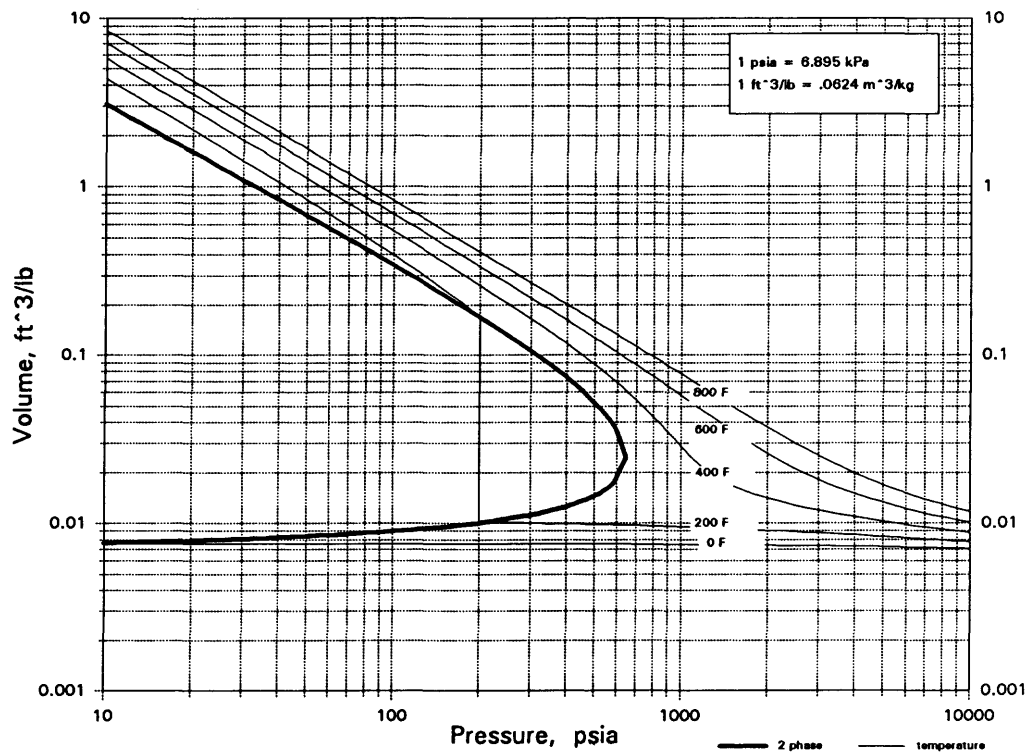


CS₂
CARBON DISULFIDE



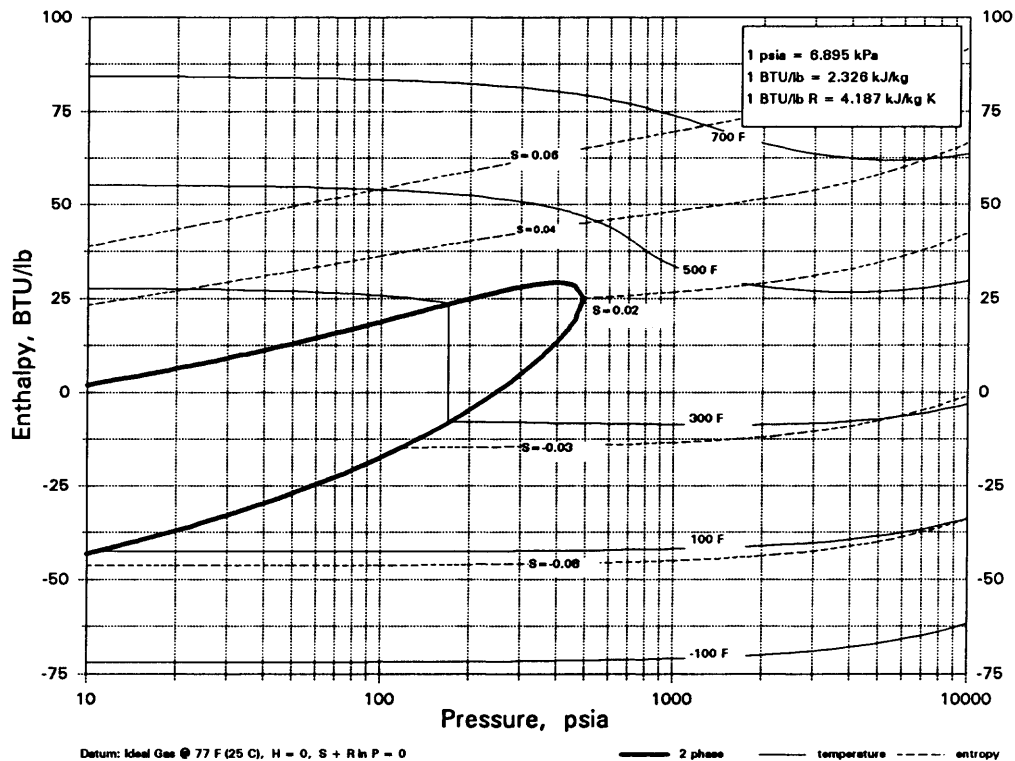
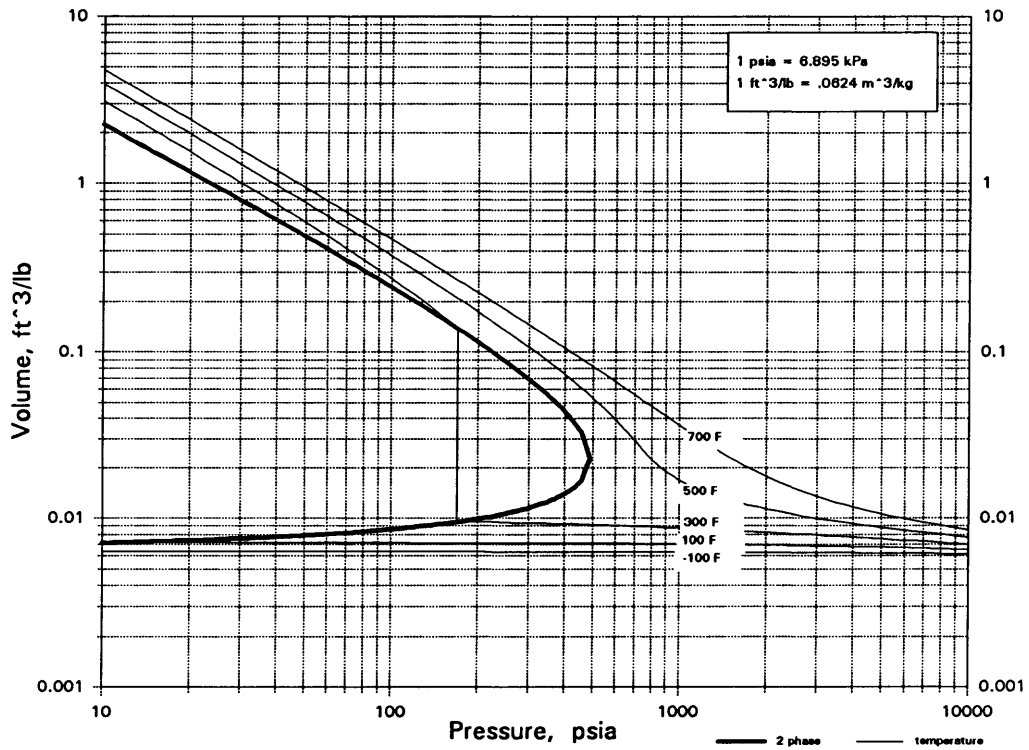
C2BrF3

BROMOTRIFLUOROETHYLENE



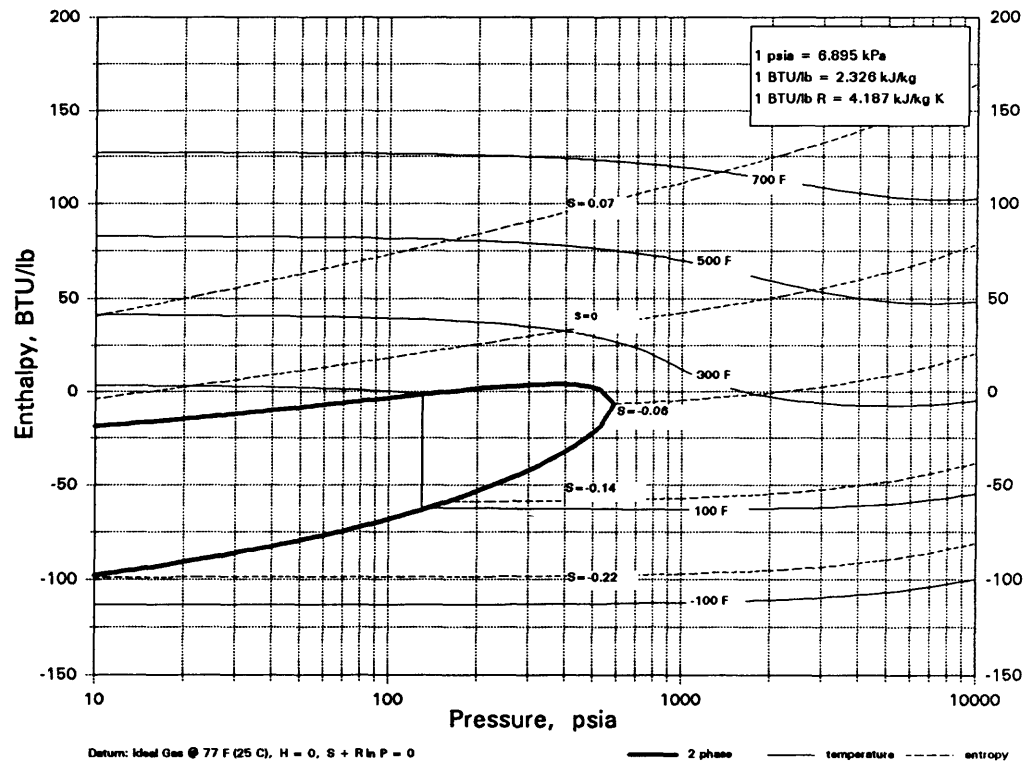
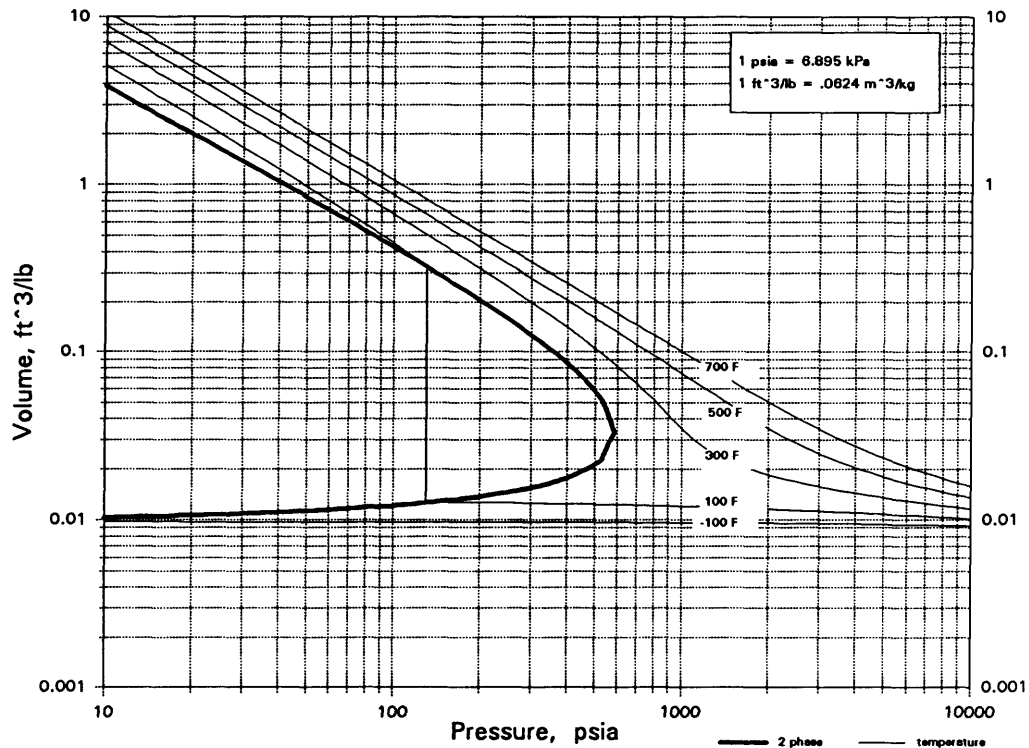
C2Br2F4

1-2-DIBROMOTETRAFLUOROETHANE



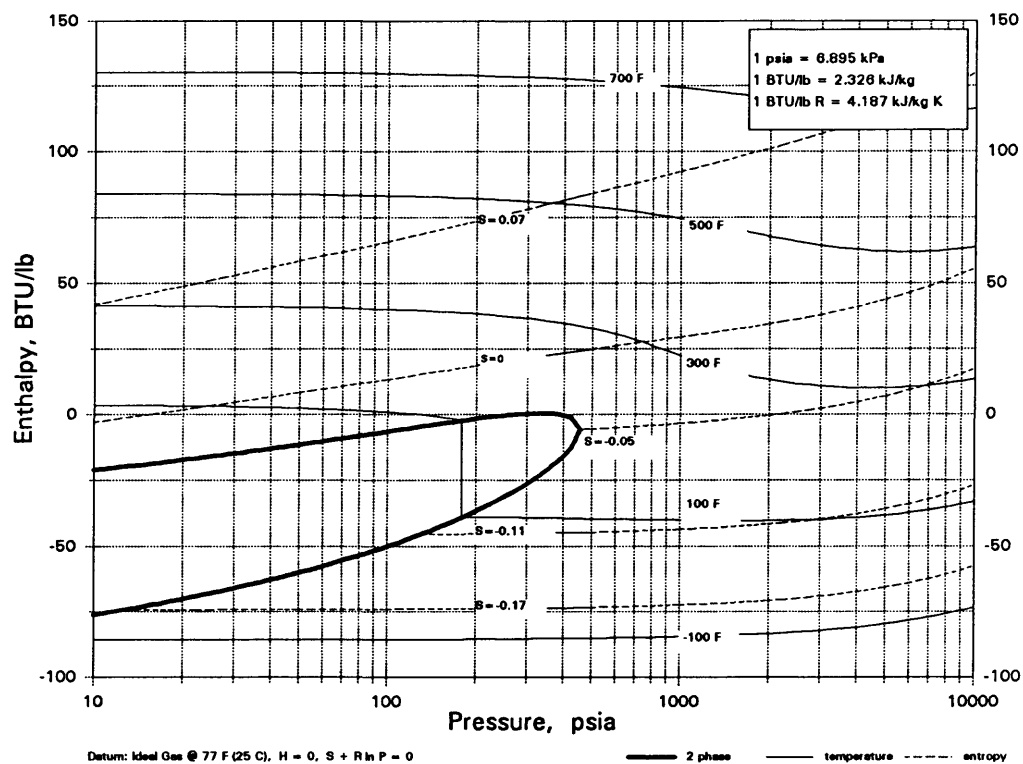
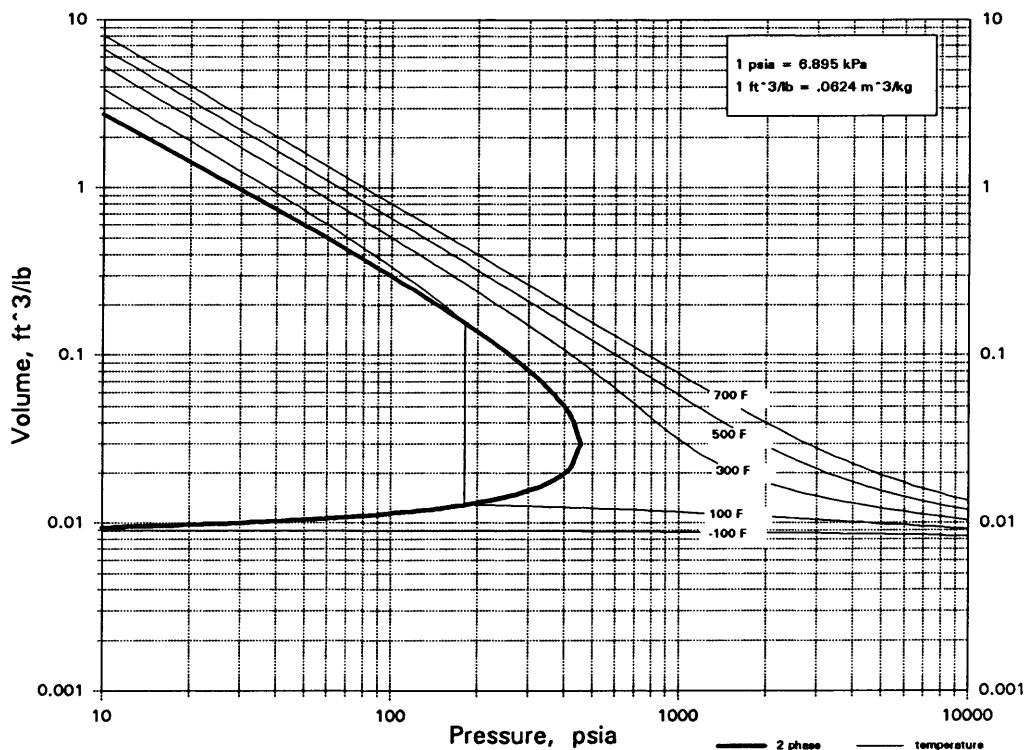
C2ClF3

CHLOROTRIFLUOROETHYLENE

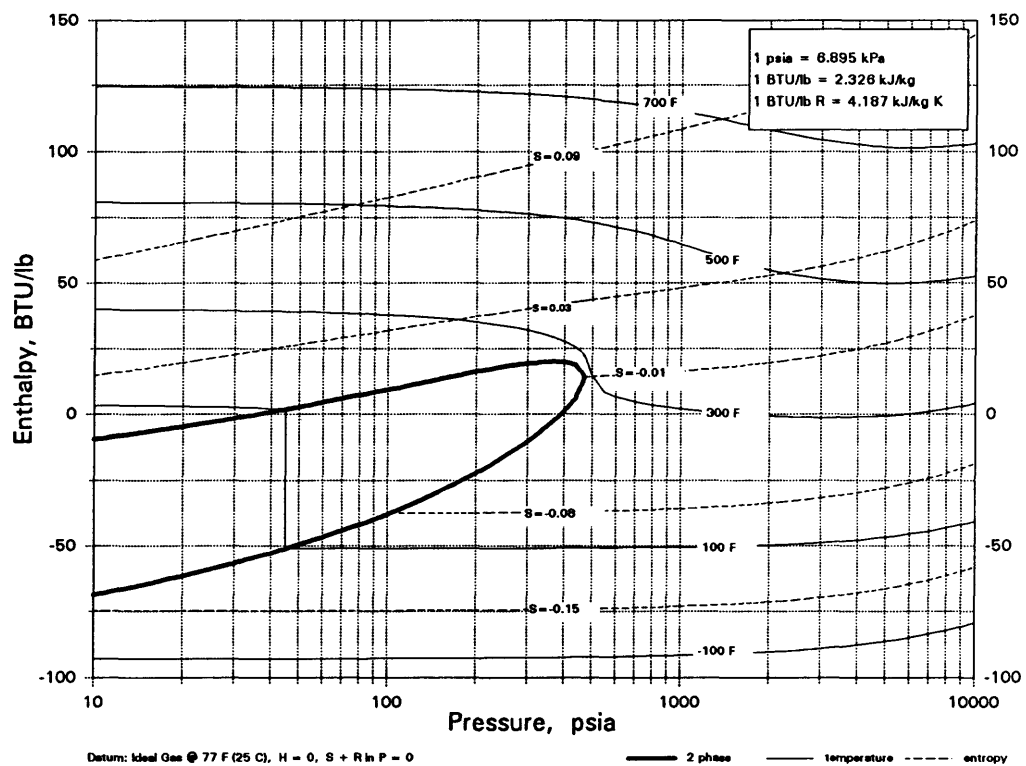
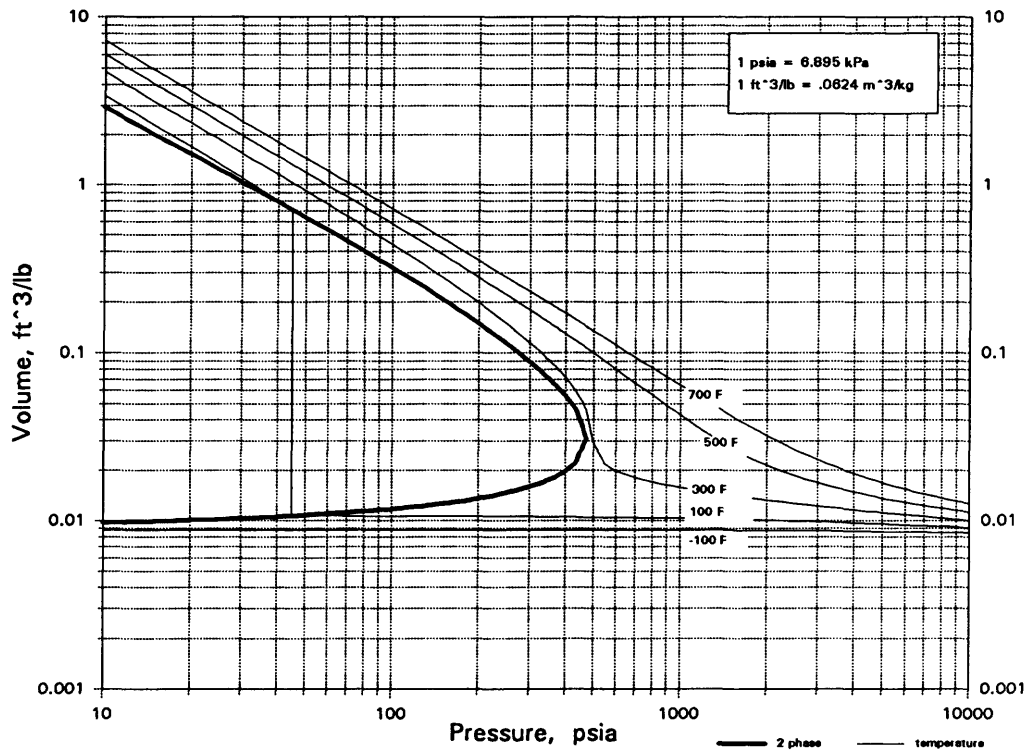


C2ClF5

CHLOROPENTAFLUOROETHANE

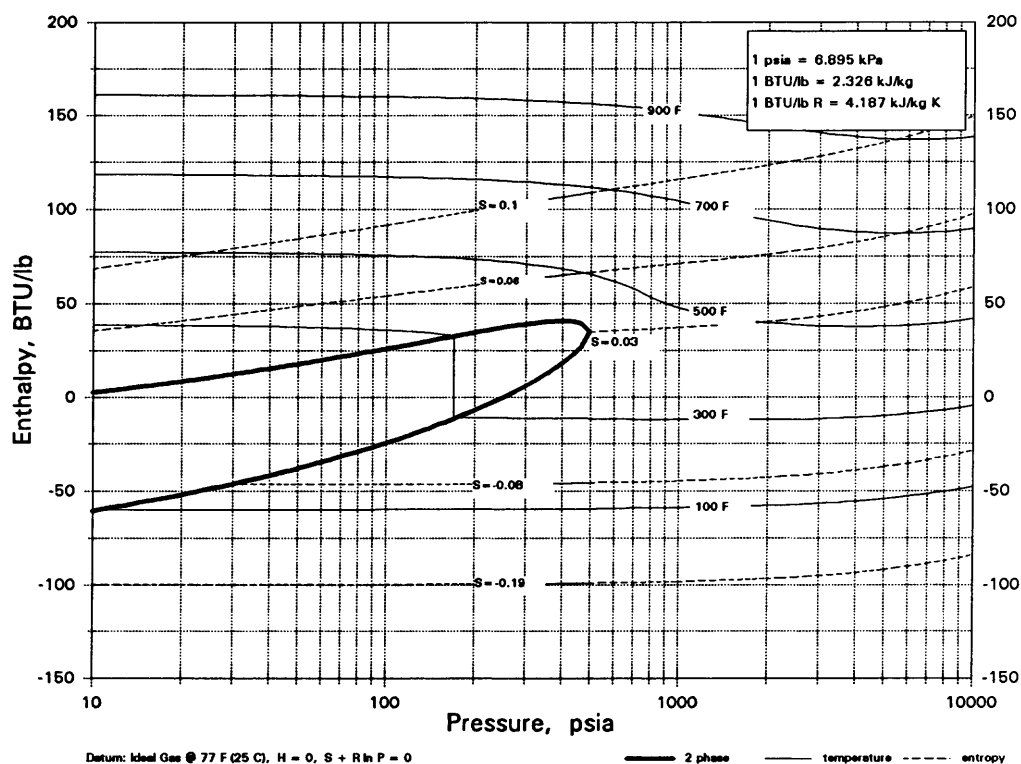
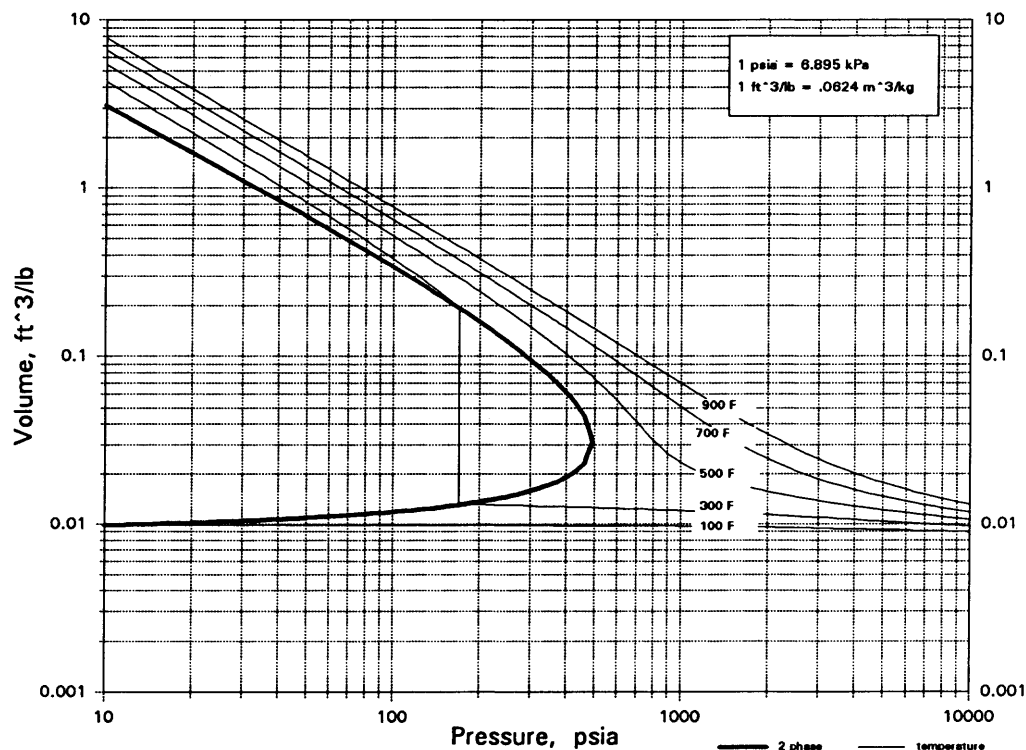


C2Cl2F4
1-2-DICHLOROTETRAFLUOROETHANE



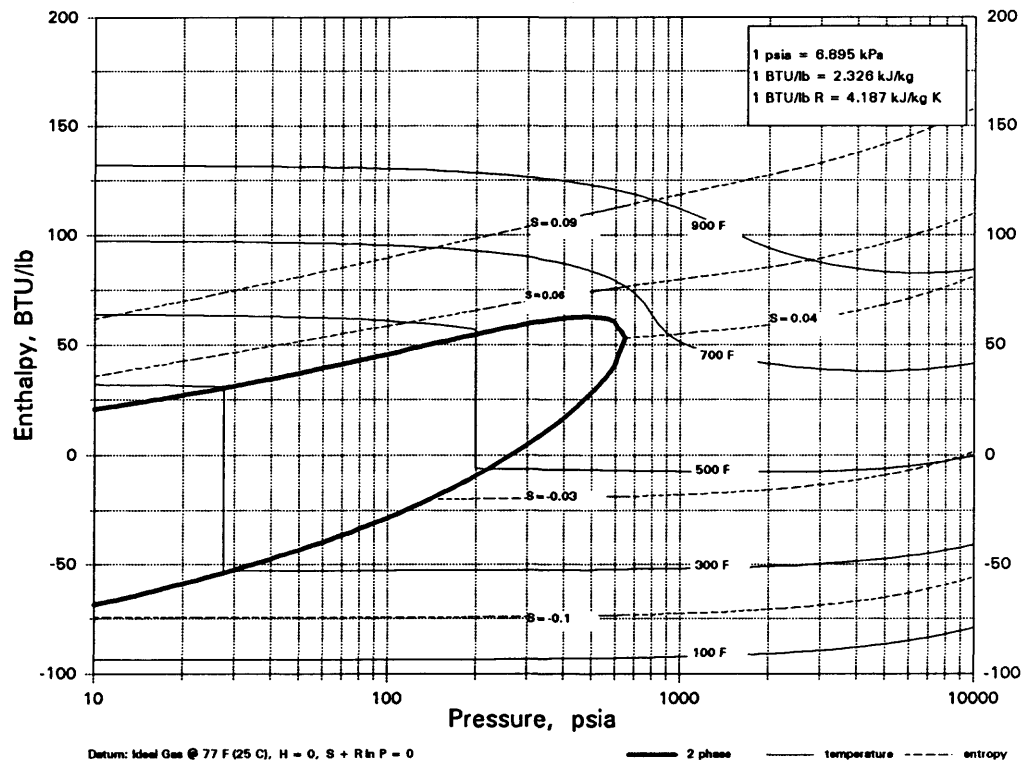
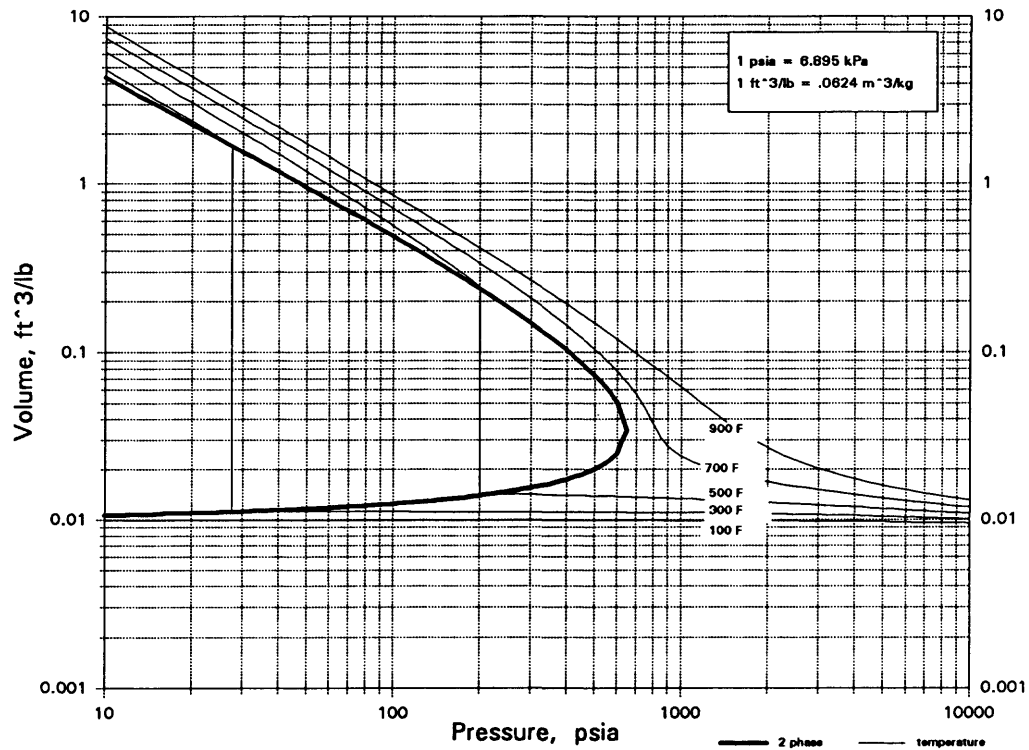
C2Cl3F3

1-1-2-TRICHLOROTRIFLUOROETHANE



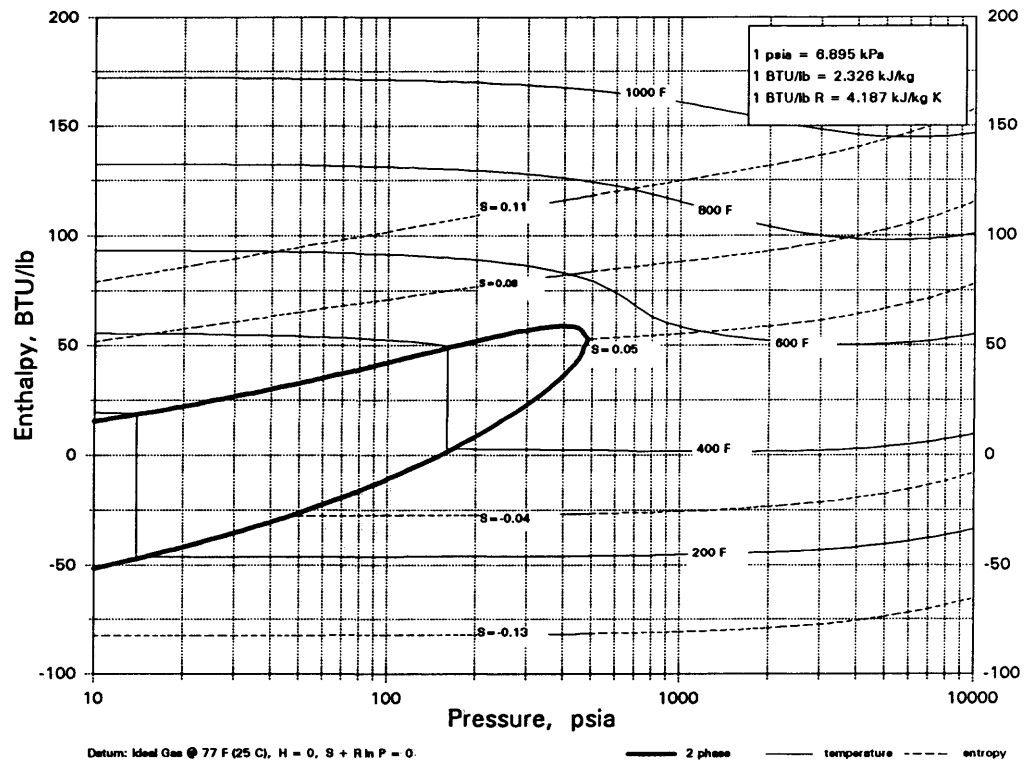
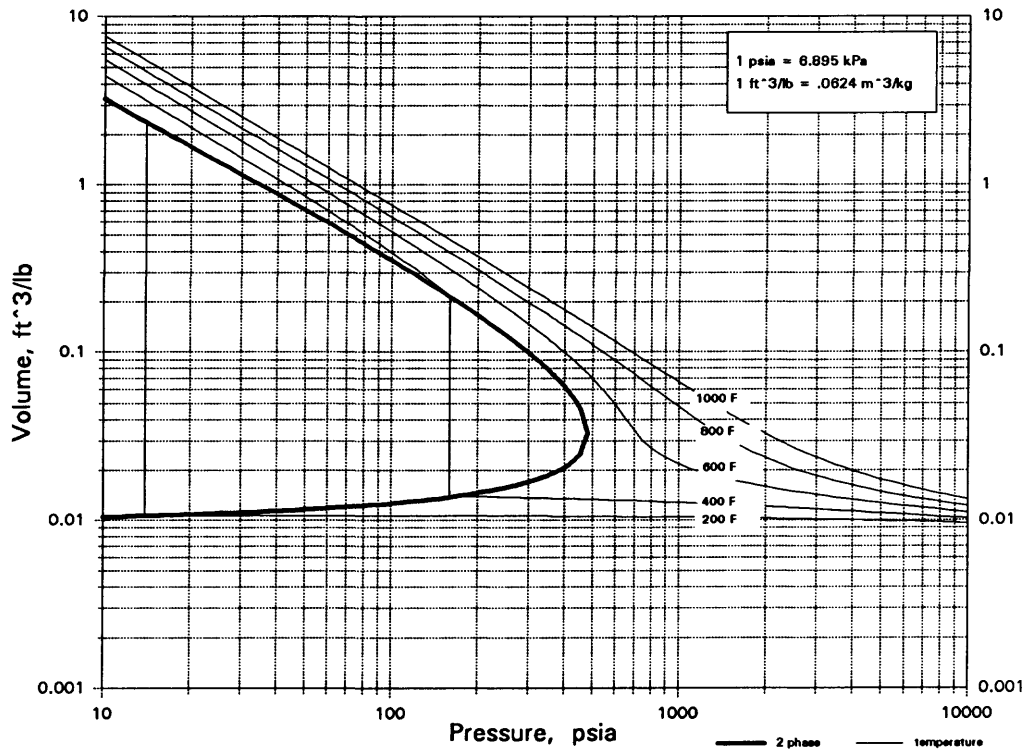
C2Cl4

TETRACHLOROETHYLENE



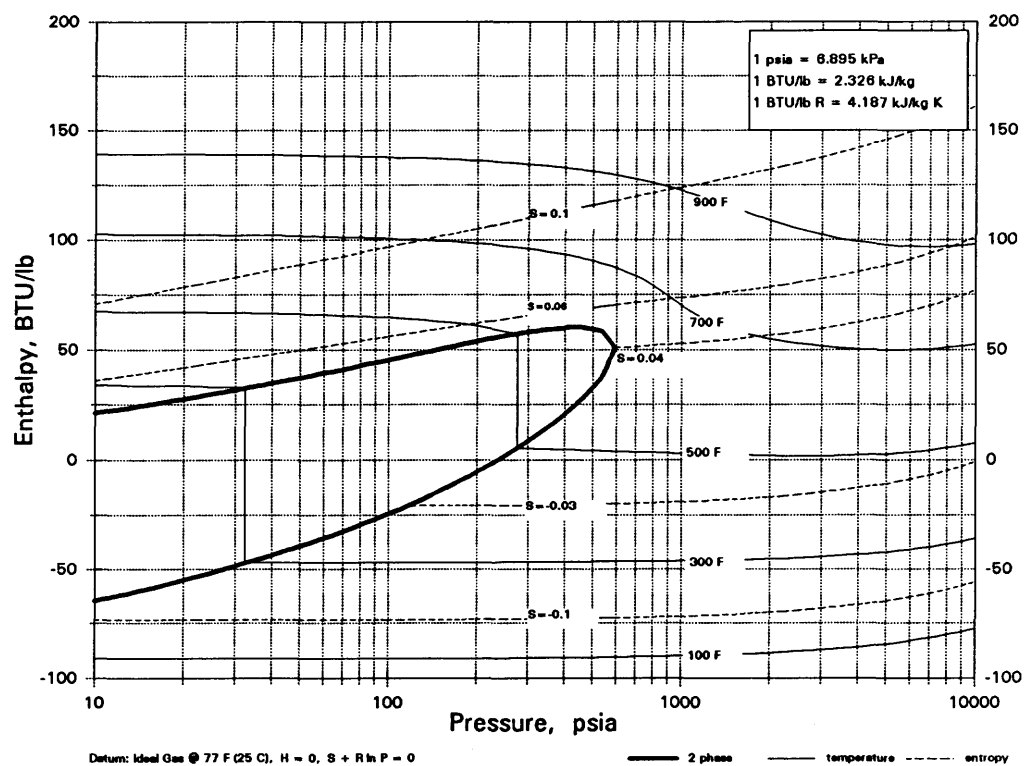
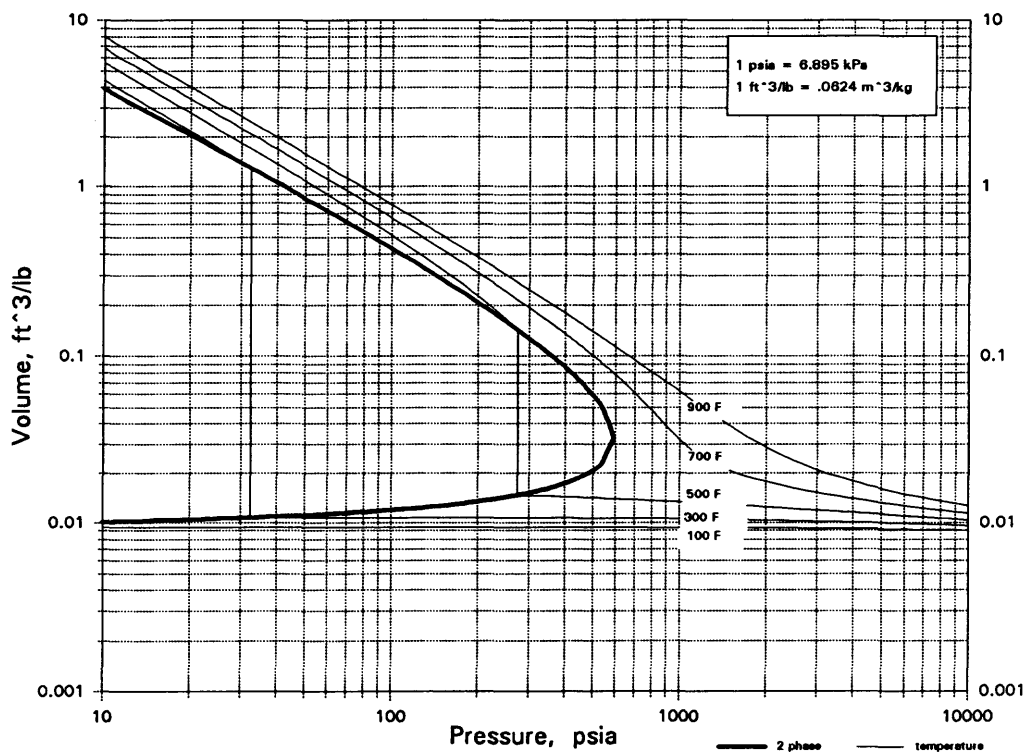
C2Cl4F2

1-1-2-2-TETRACHLORODIFLUOROETHANE



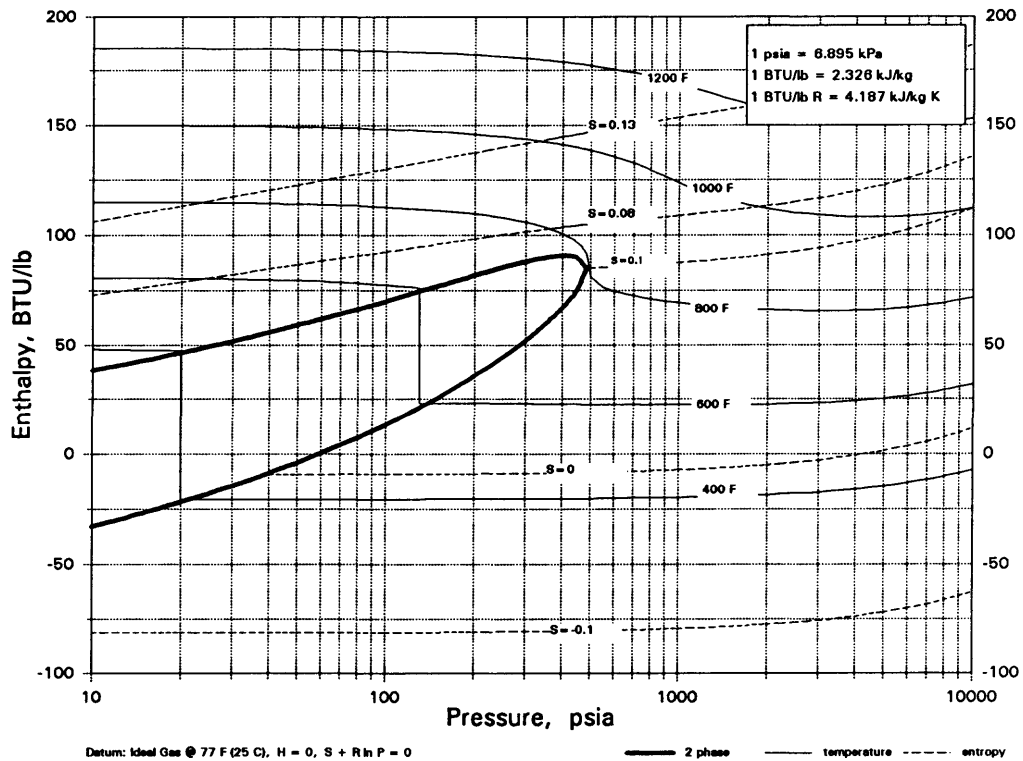
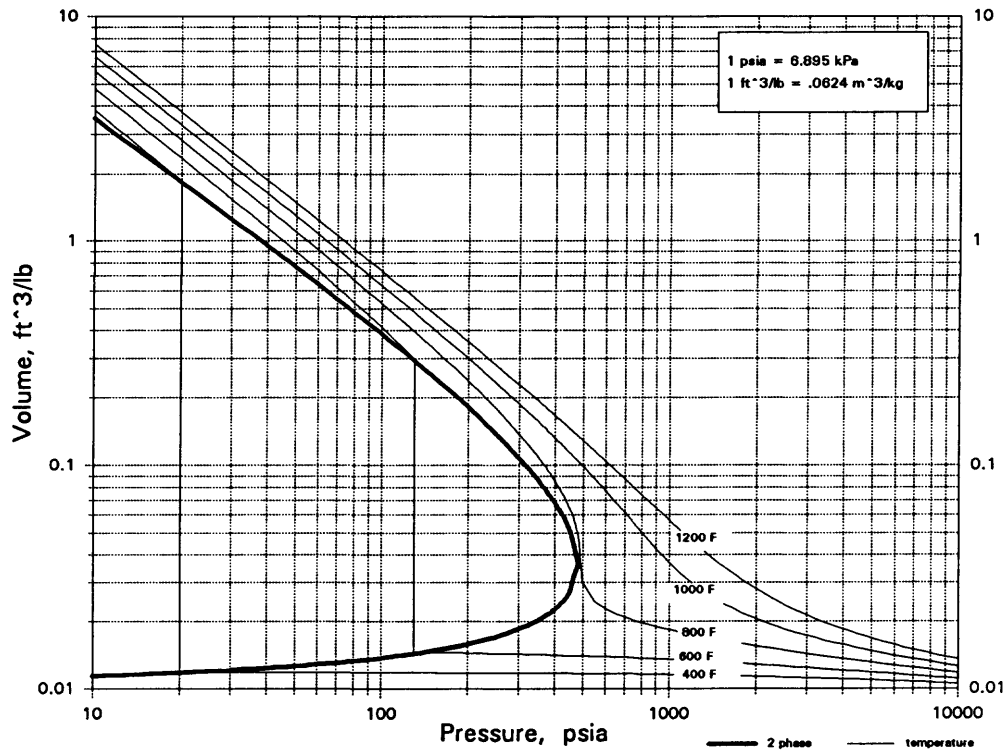
C2Cl4O

TRICHLOROACETYL CHLORIDE

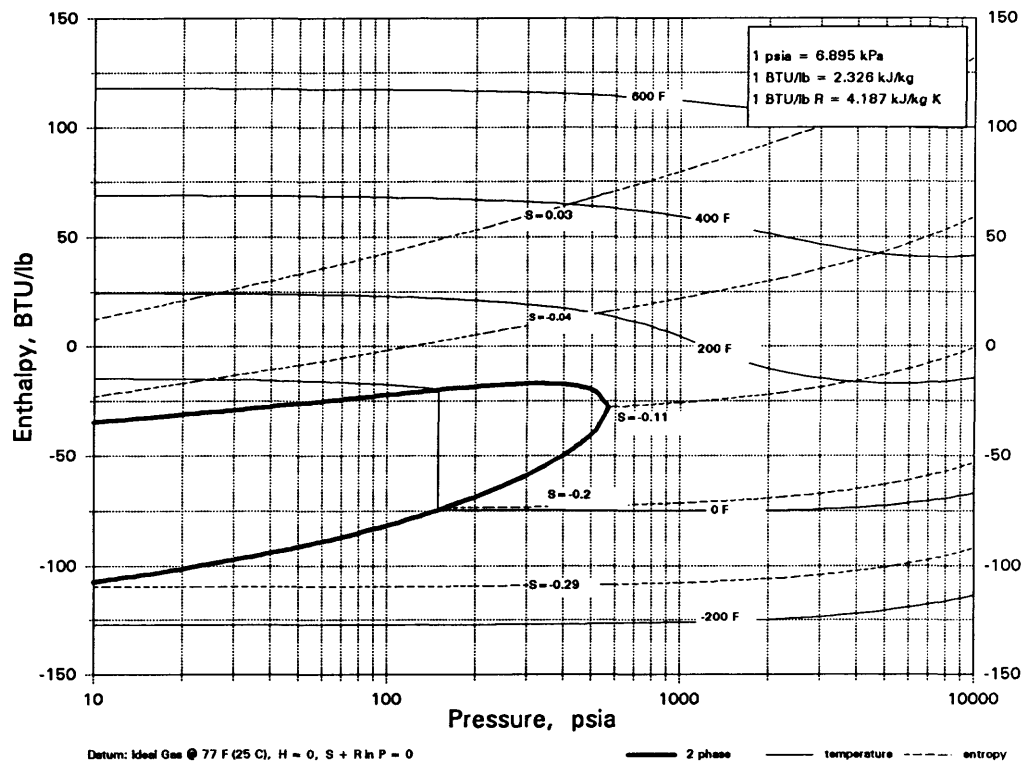
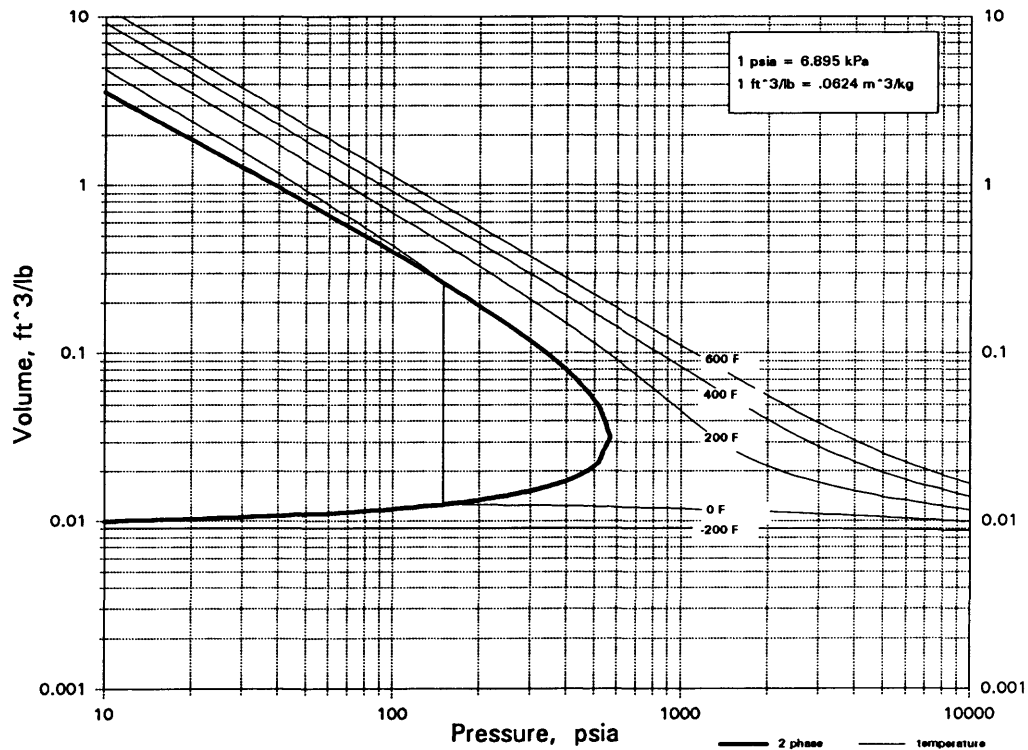


C2Cl6

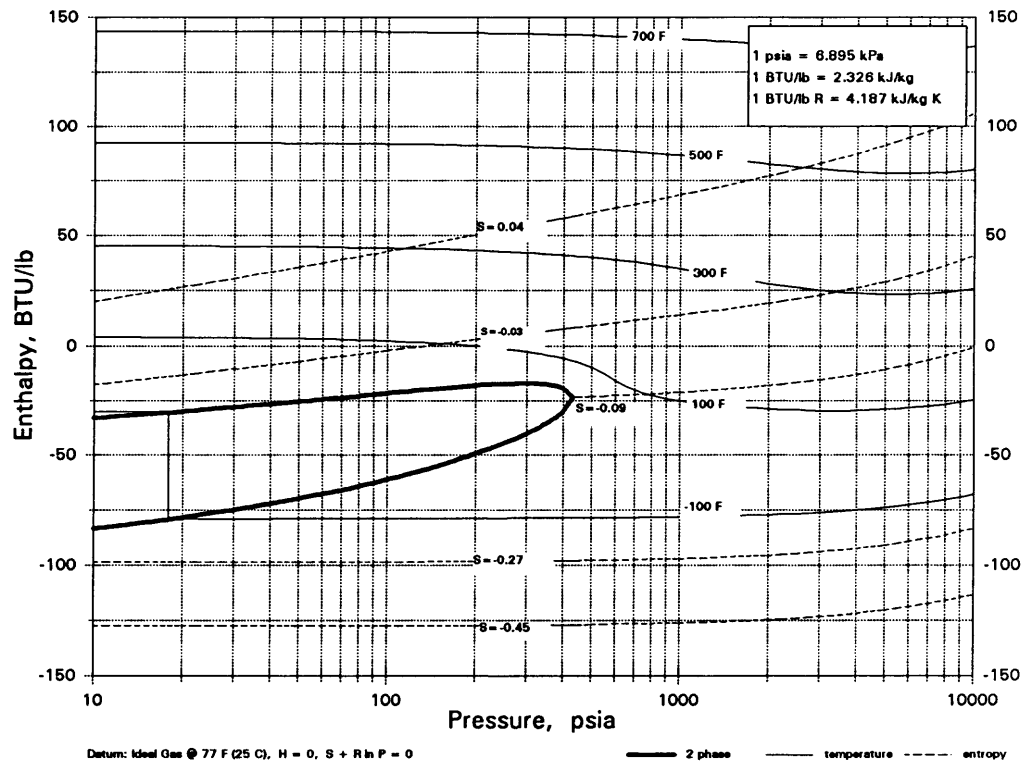
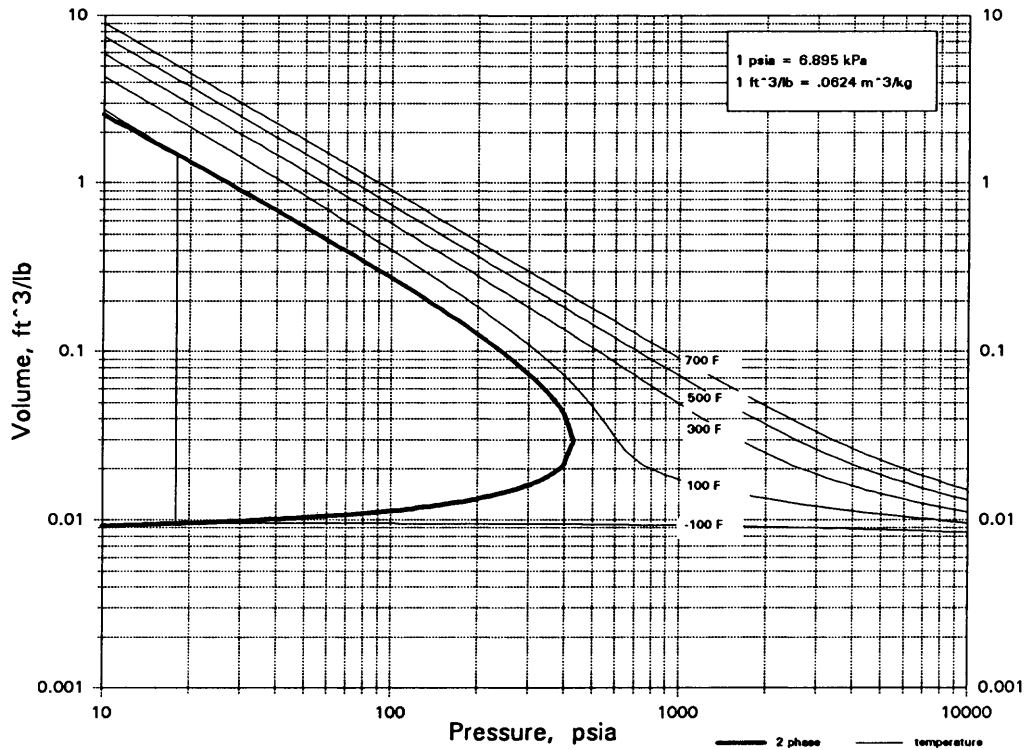
HEXACHLOROETHANE



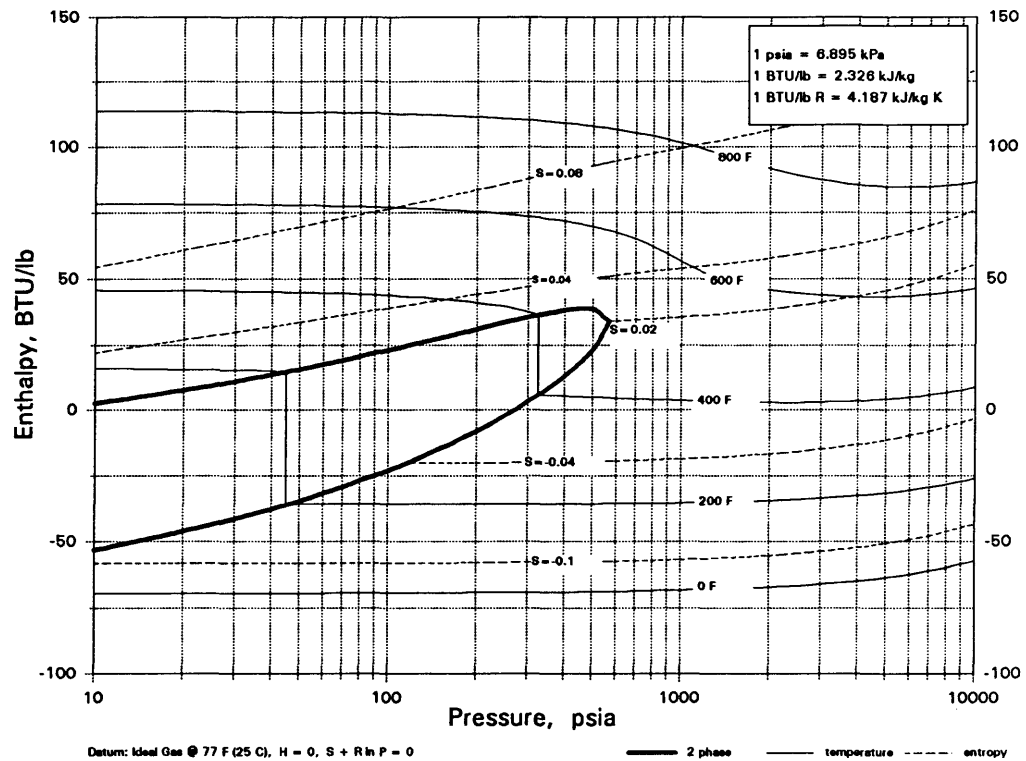
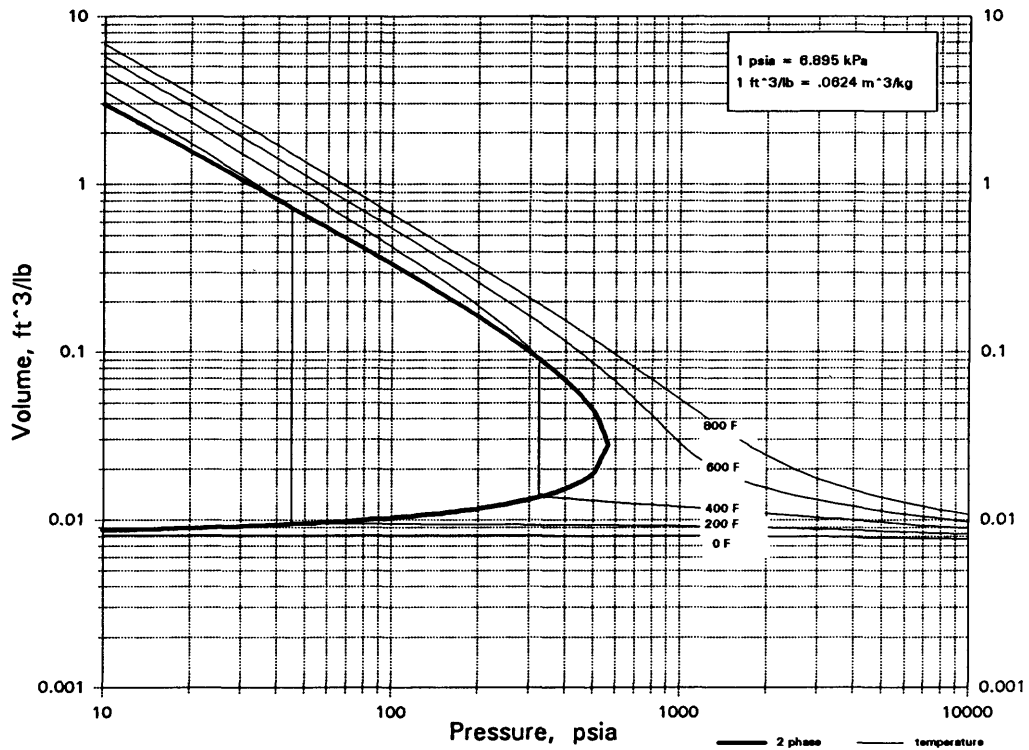
C2F4
TETRAFLUOROETHYLENE



C2F6
HEXAFLUOROETHANE

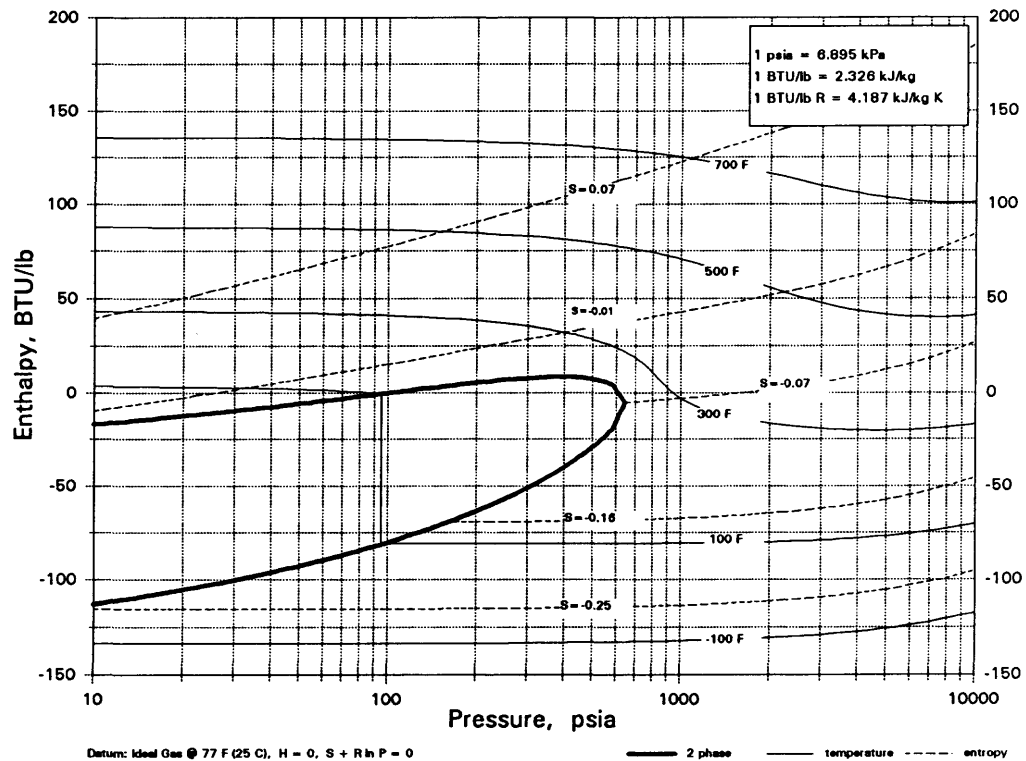
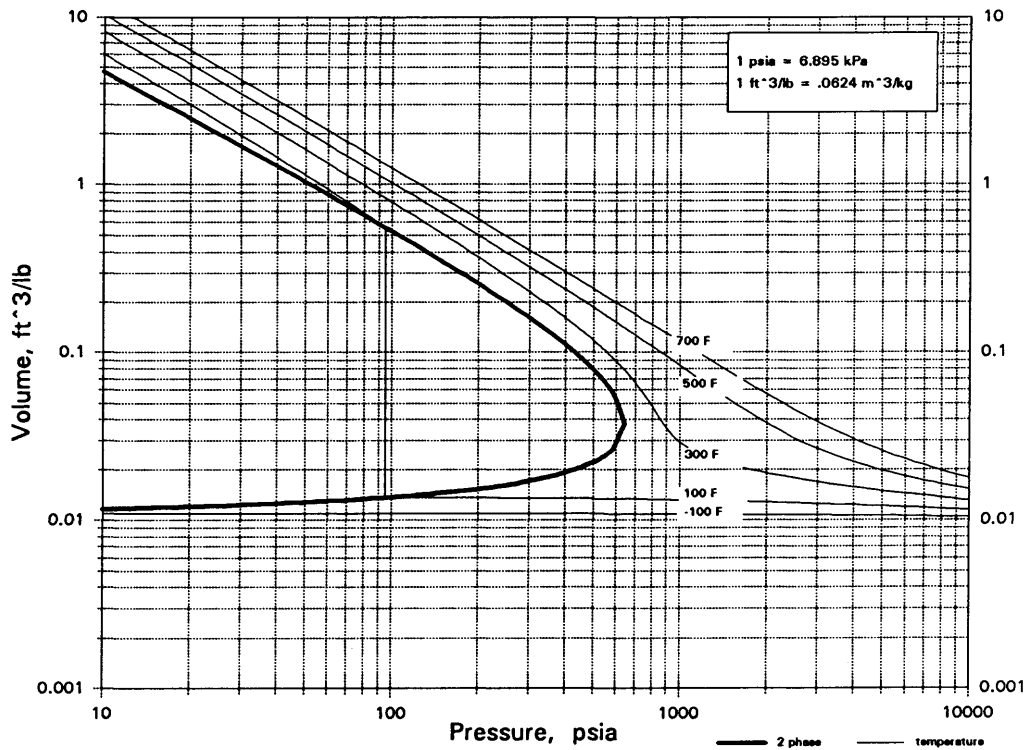


C2HBrCIF3 HALOTHANE

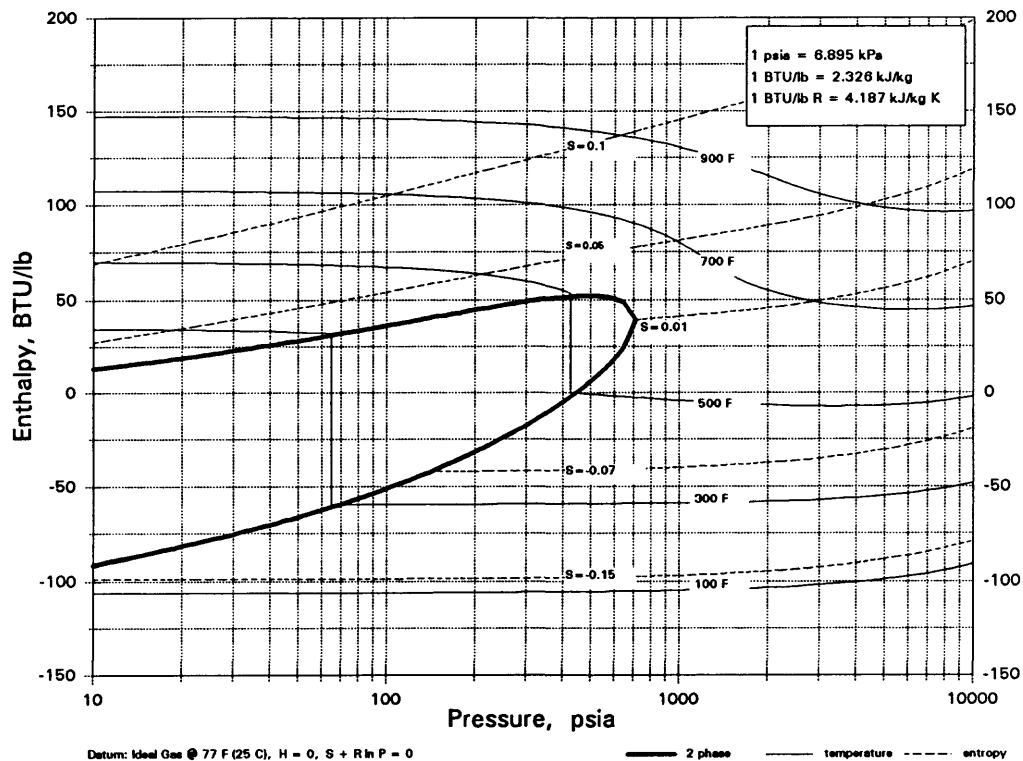
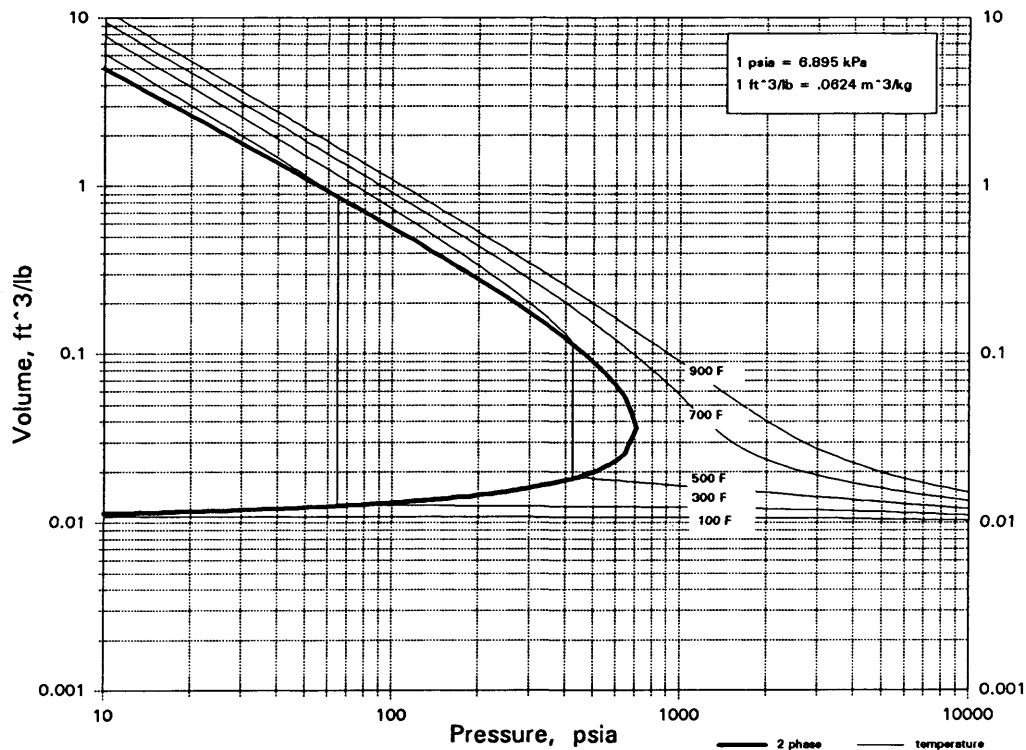


C2HClF2

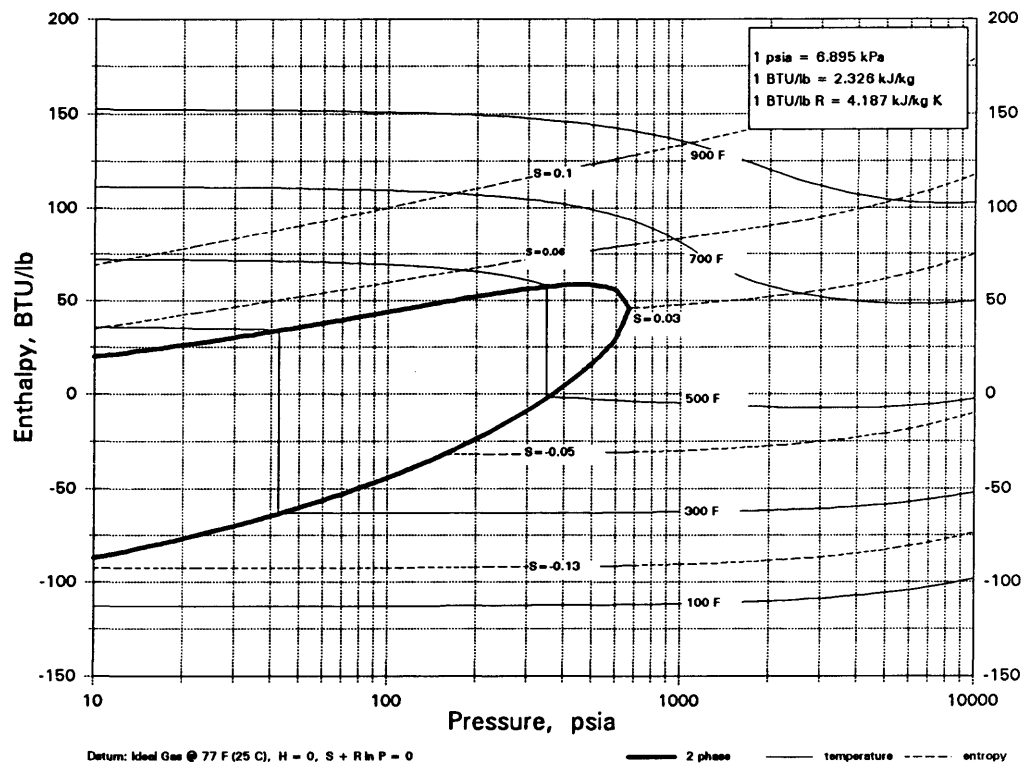
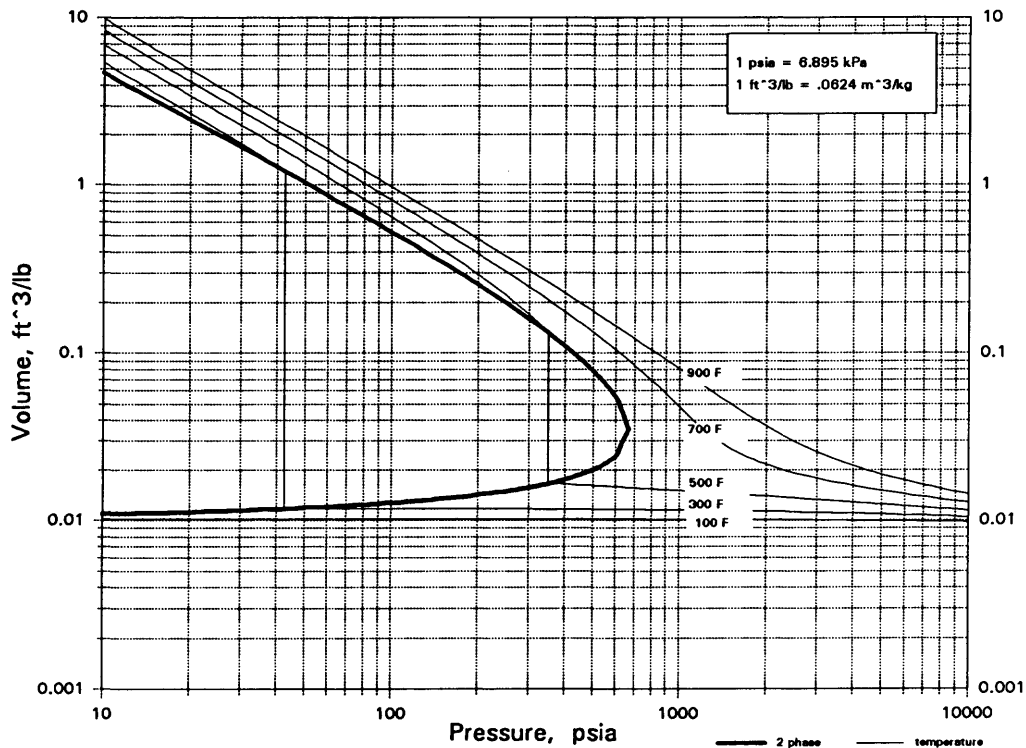
2-CHLORO-1-1-DIFLUOROETHYLENE



C2HCl3
TRICHLOROETHYLENE

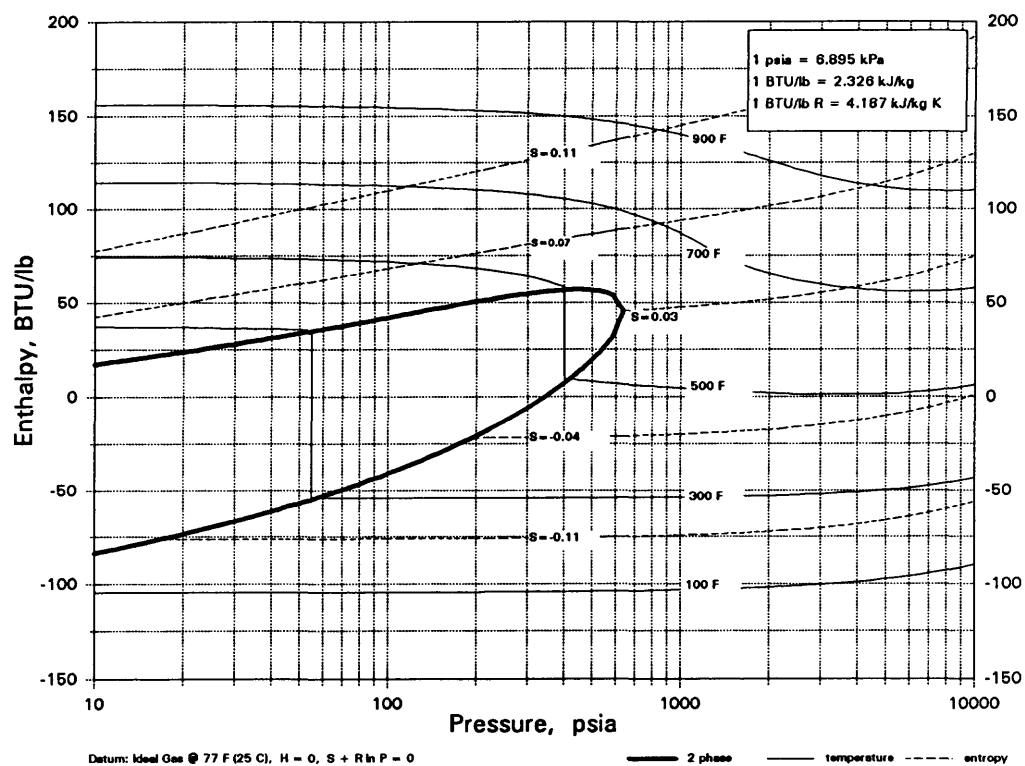
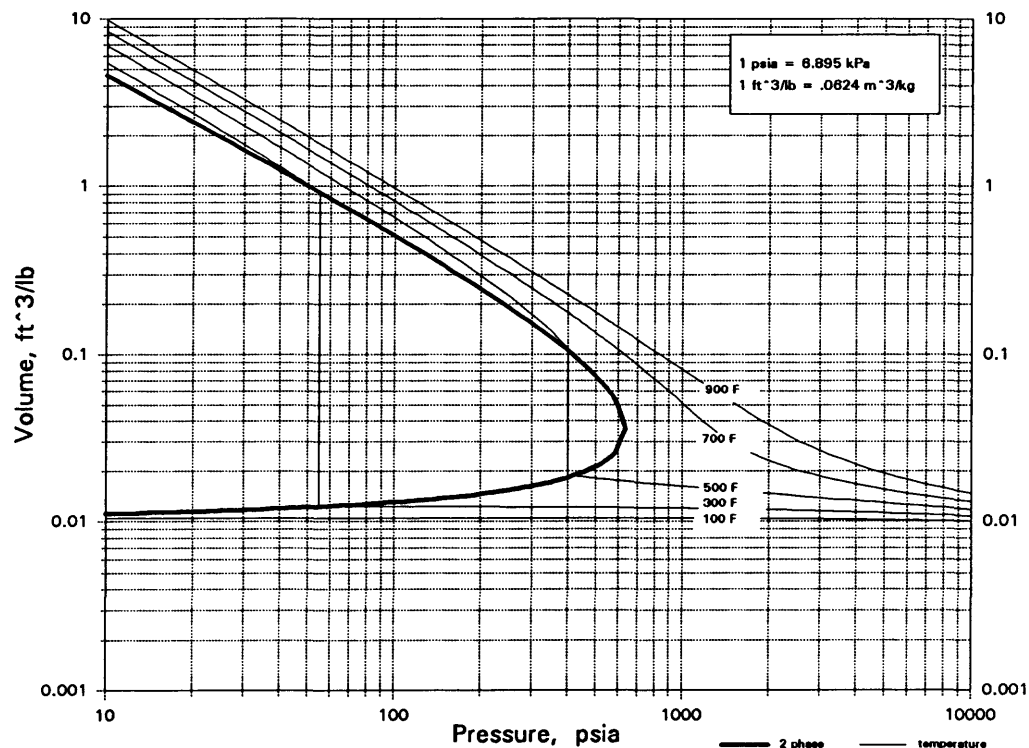


C2HCl3O
DICHLOROACETYL CHLORIDE

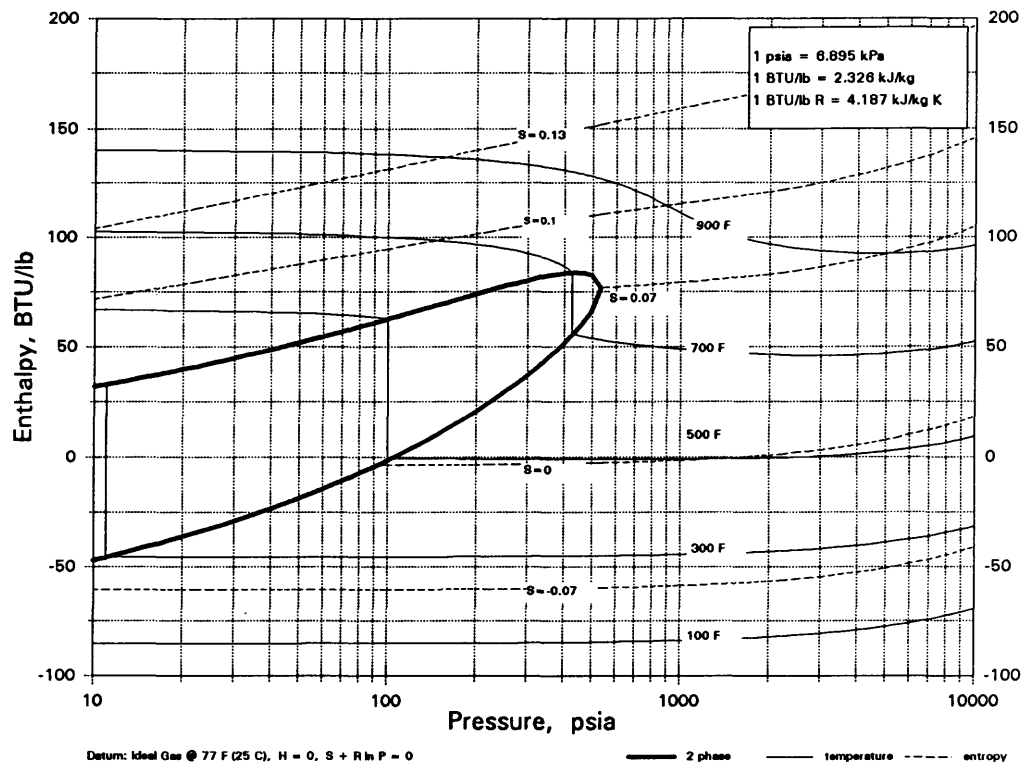
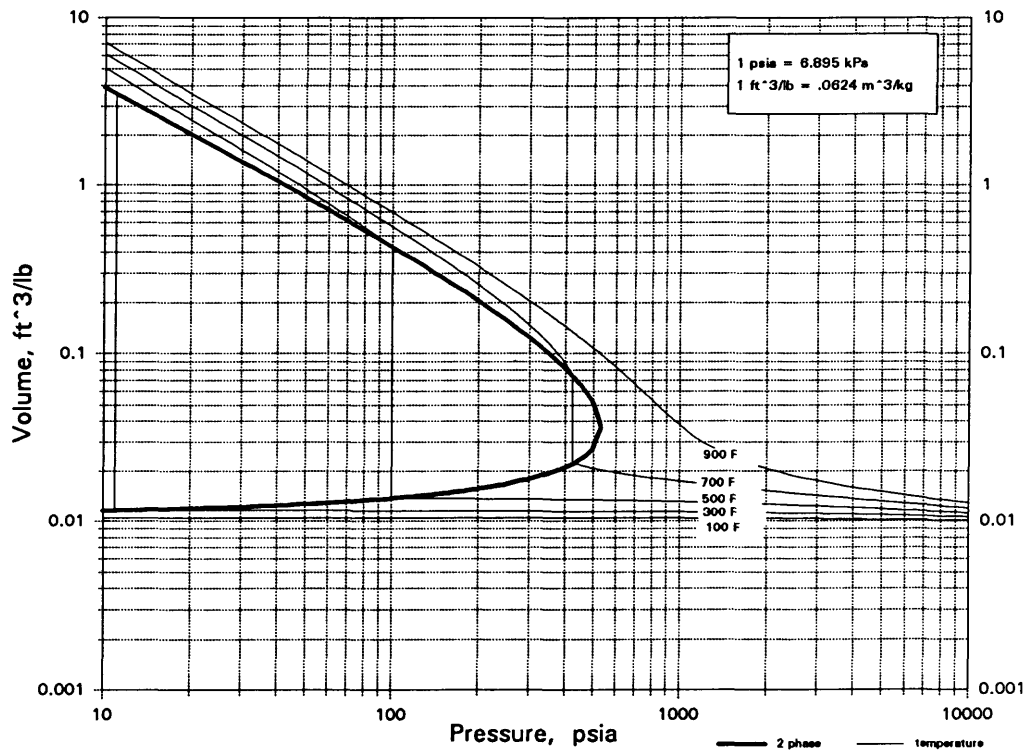


C2HCl3O

TRICHLOROACETALDEHYDE

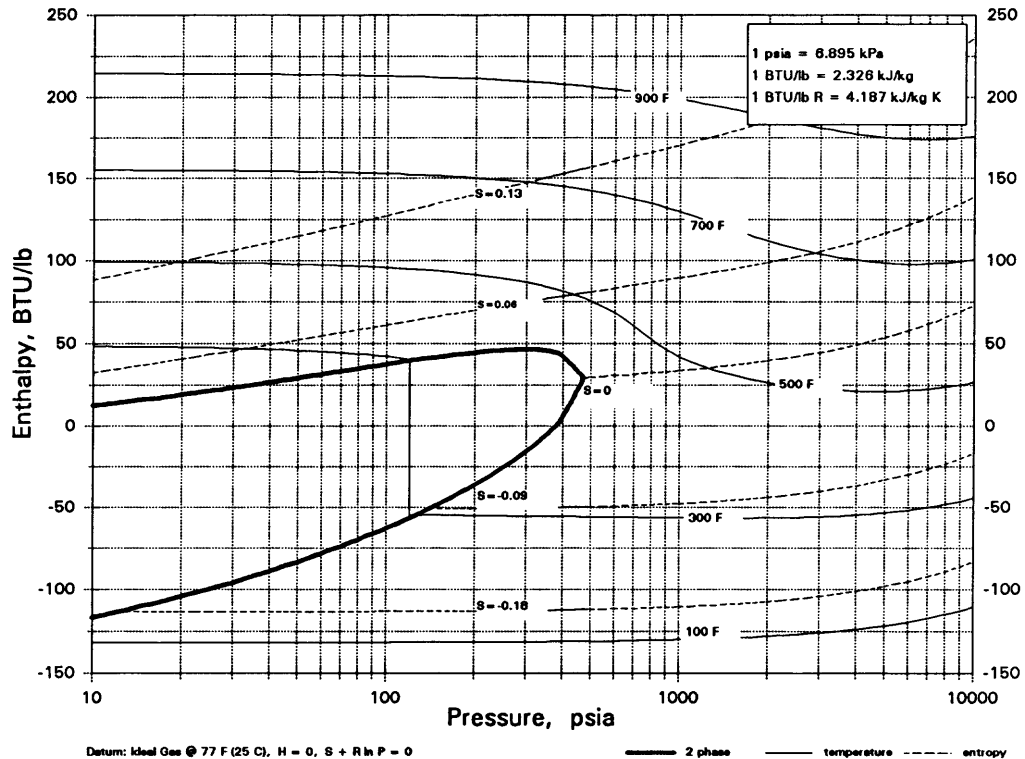
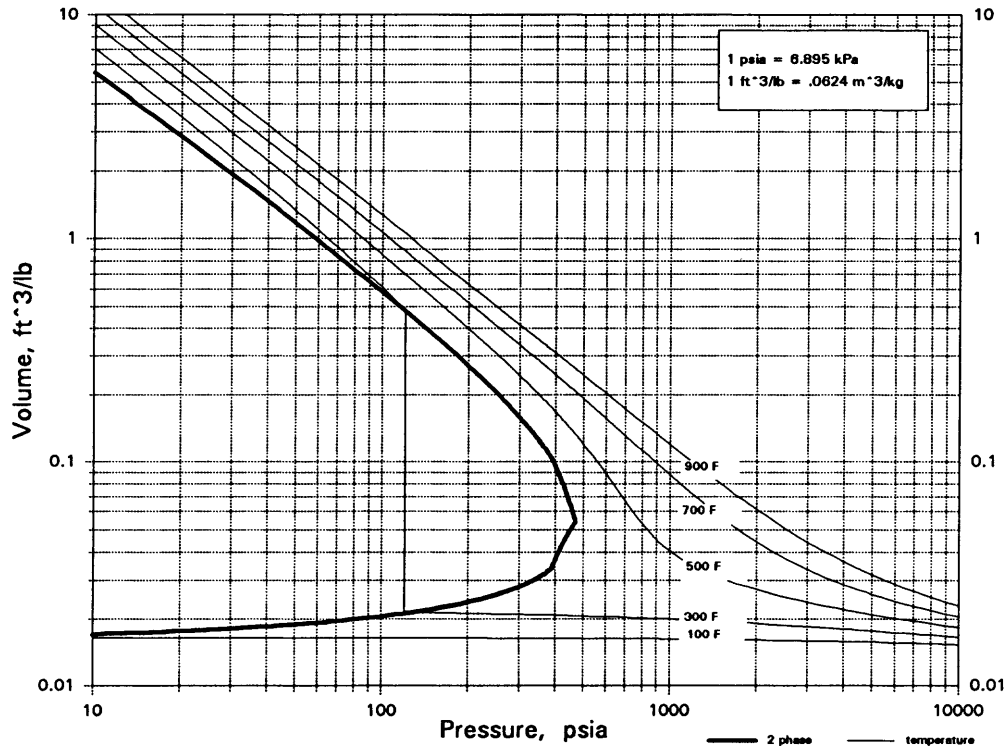


C2HCl5
PENTACHLOROETHANE



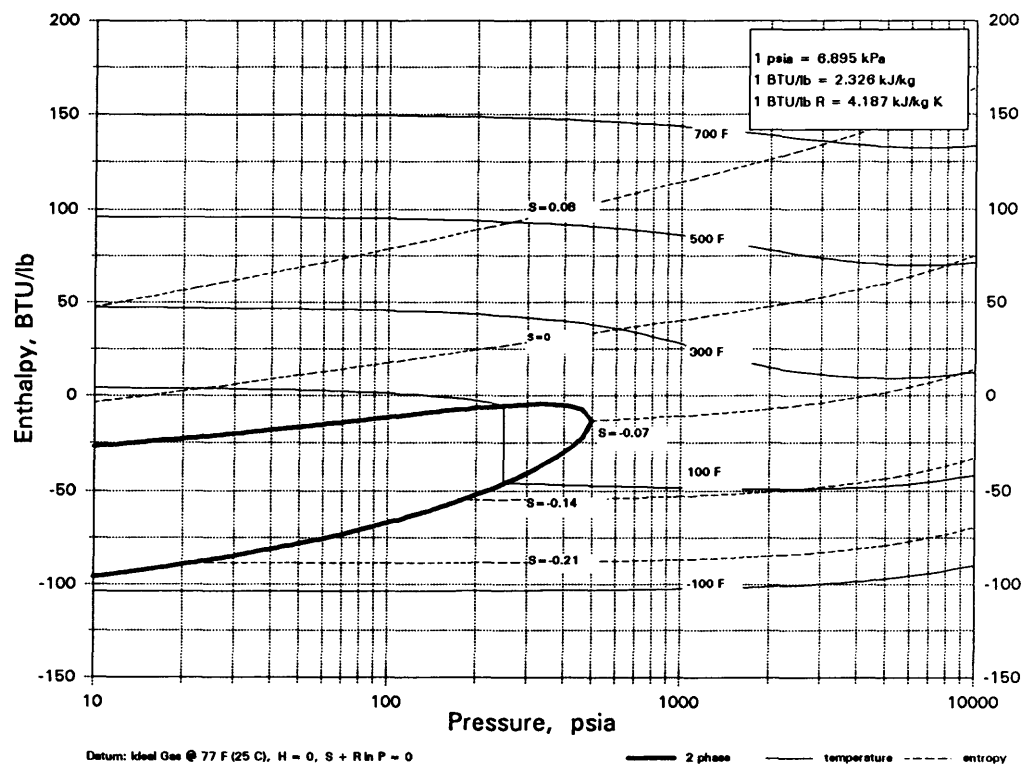
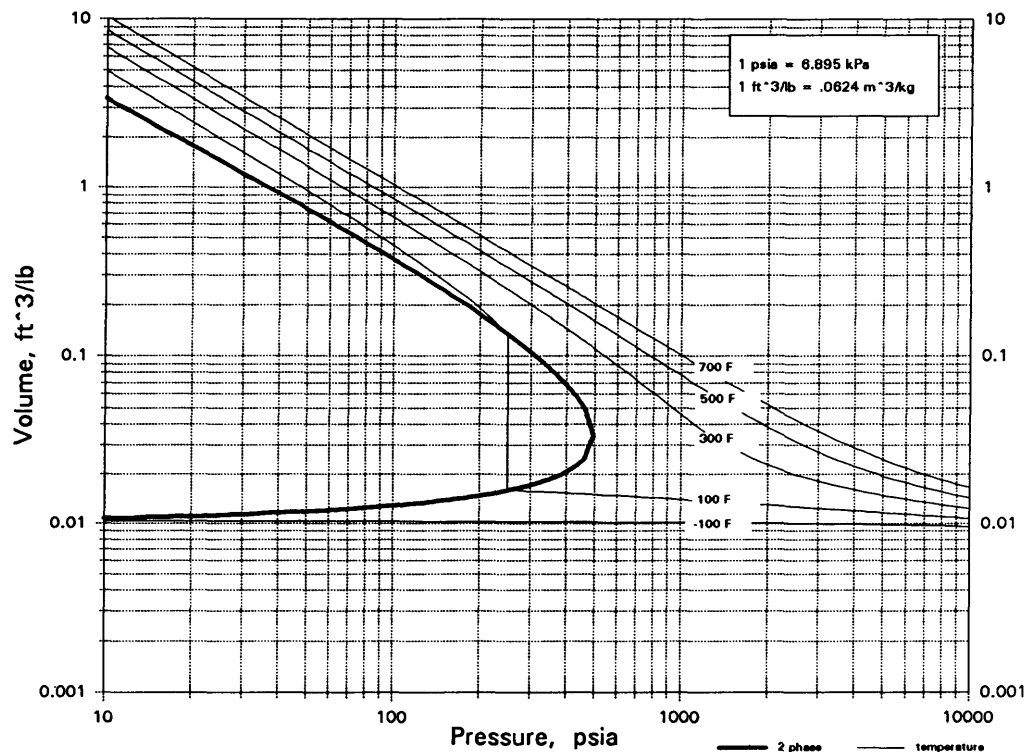
C2HF3O2

TRIFLUOROACETIC ACID

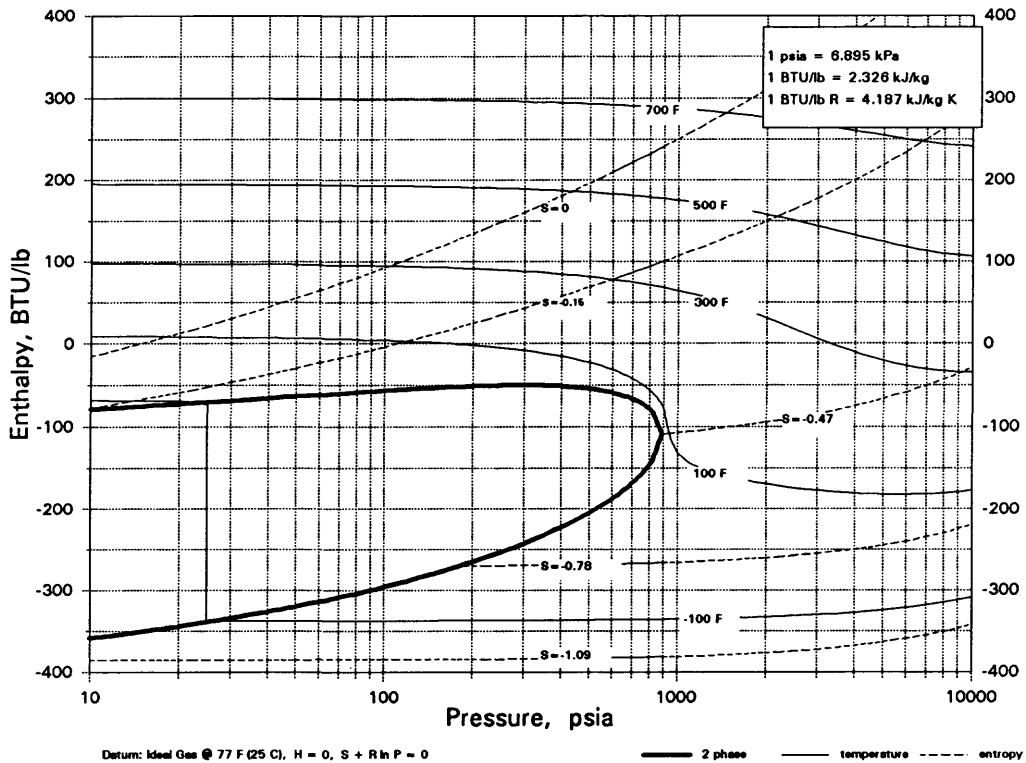
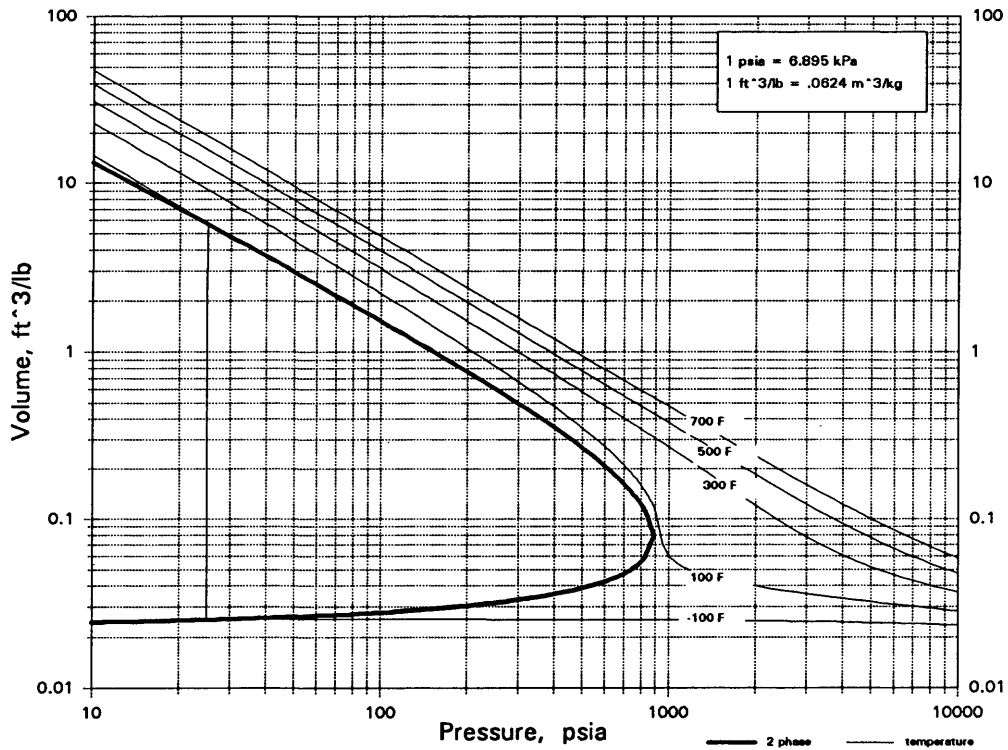


C2HF5

PENTAFLUOROETHANE

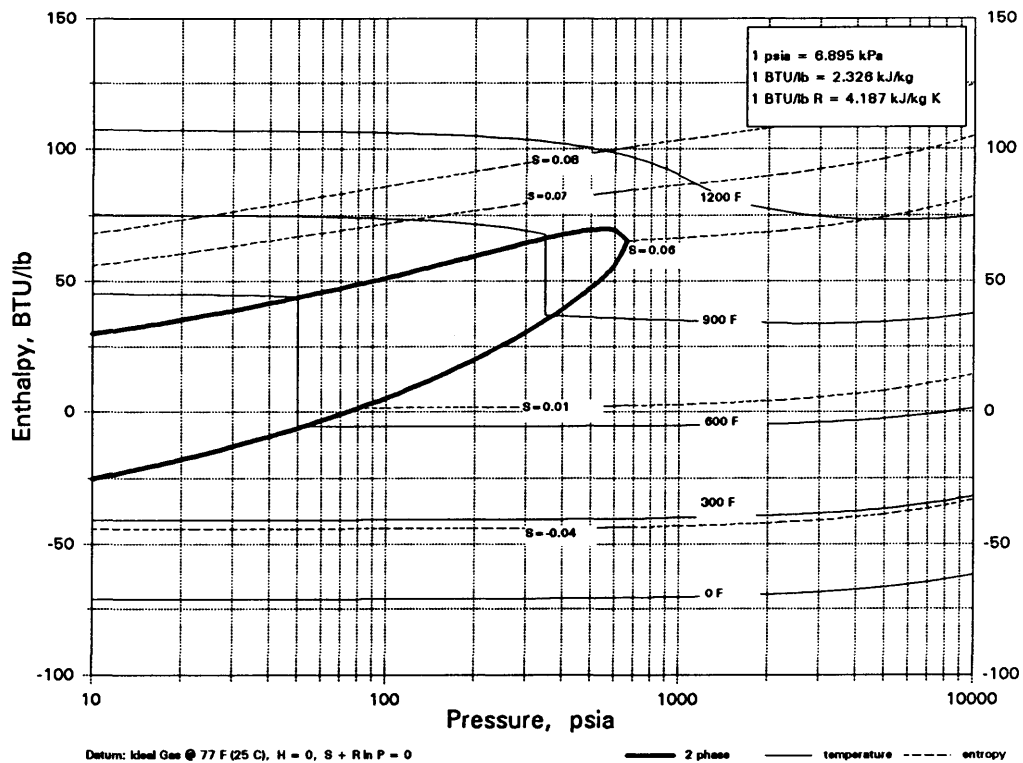
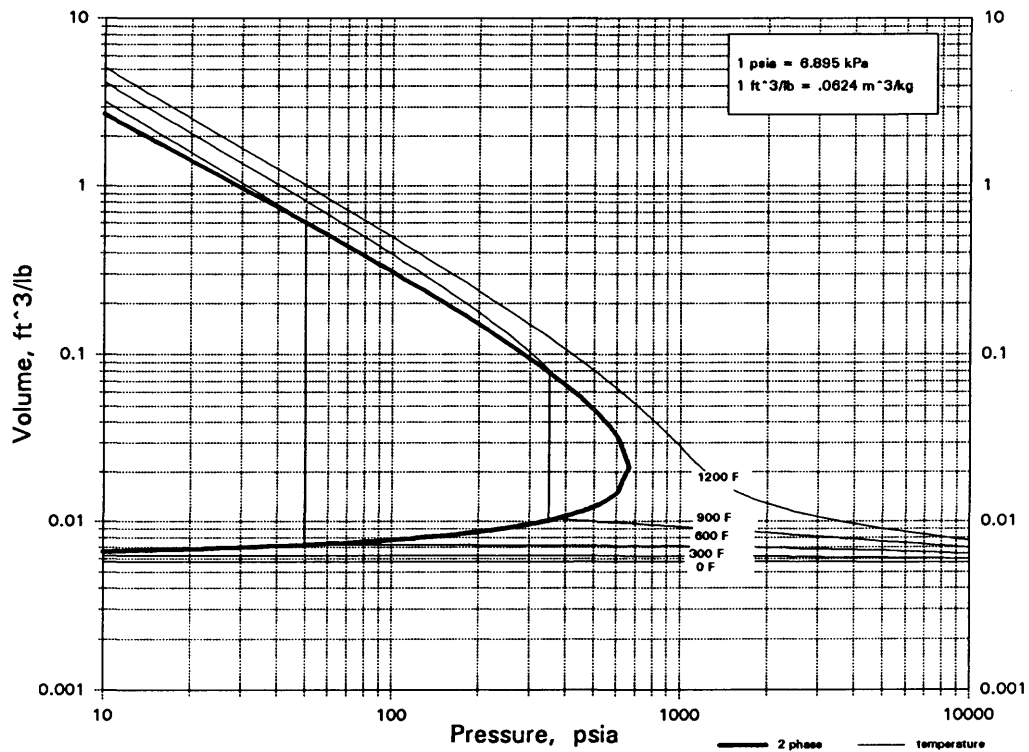


C2H2
ACETYLENE



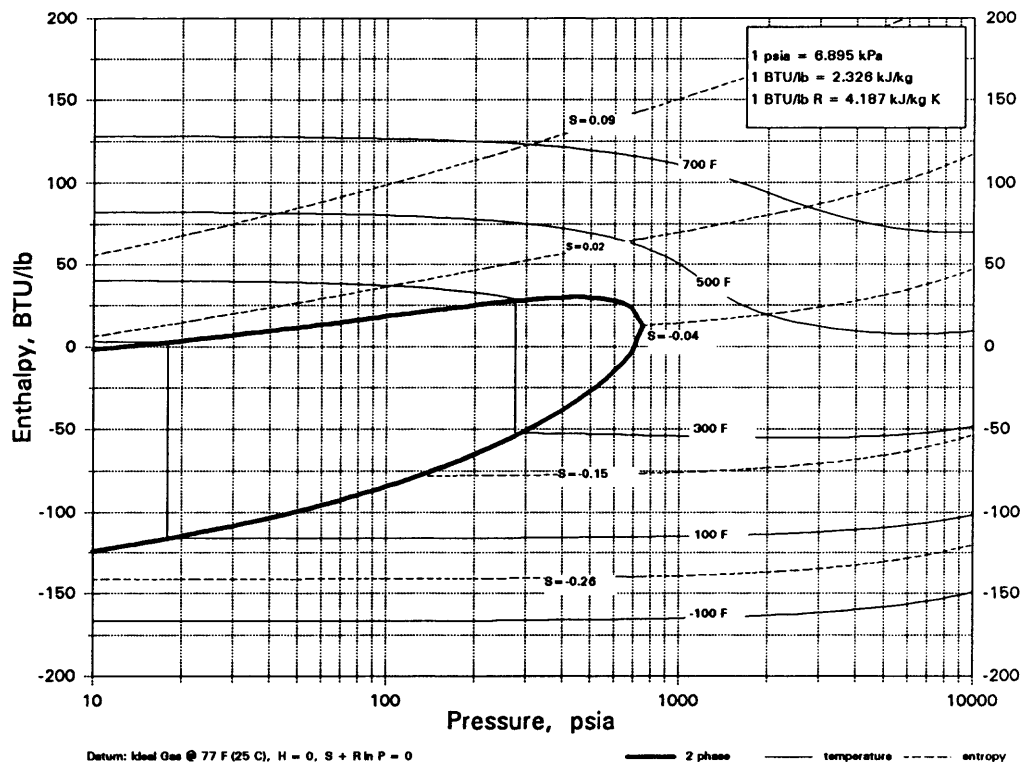
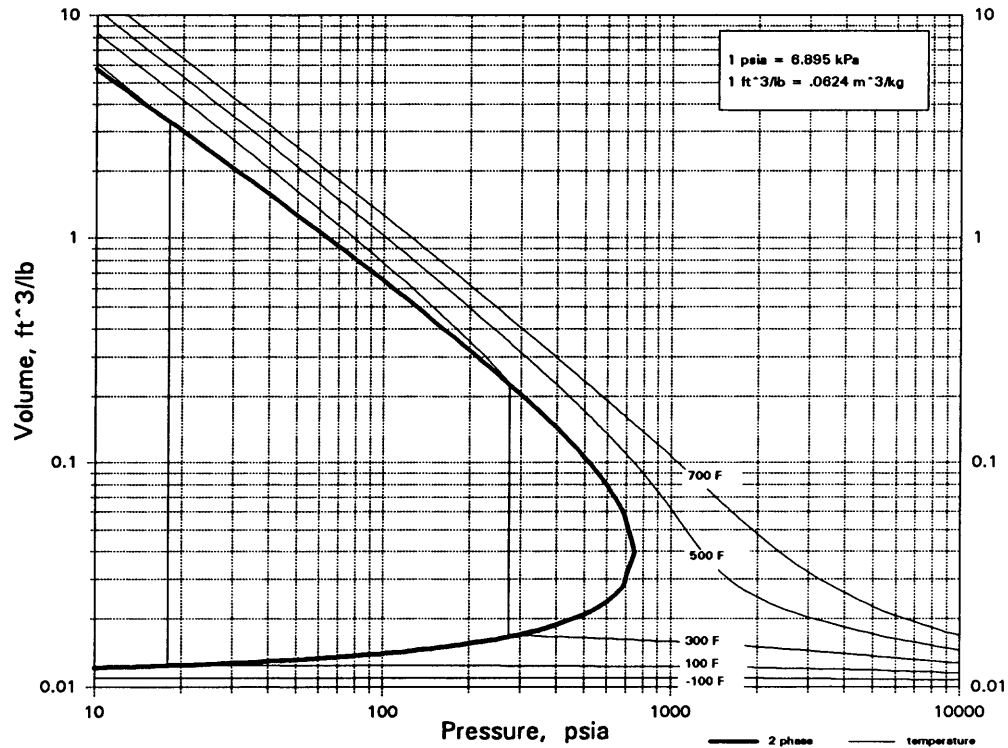
C₂H₂Br₄

1-1-2-2-TETRABROMOETHANE



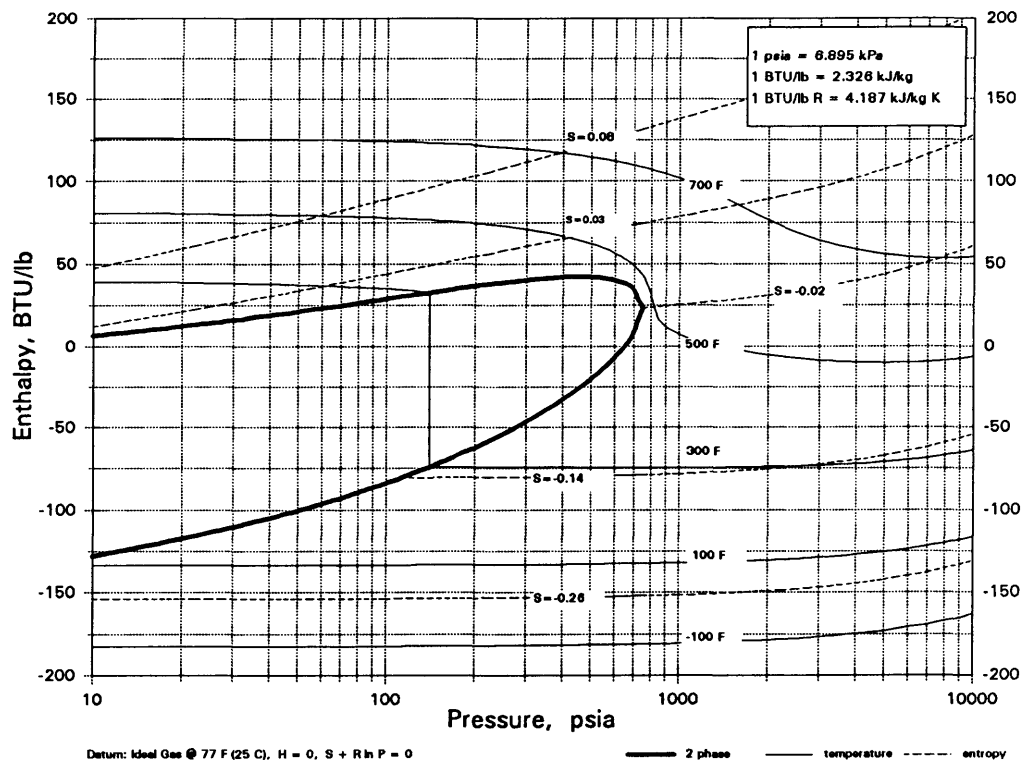
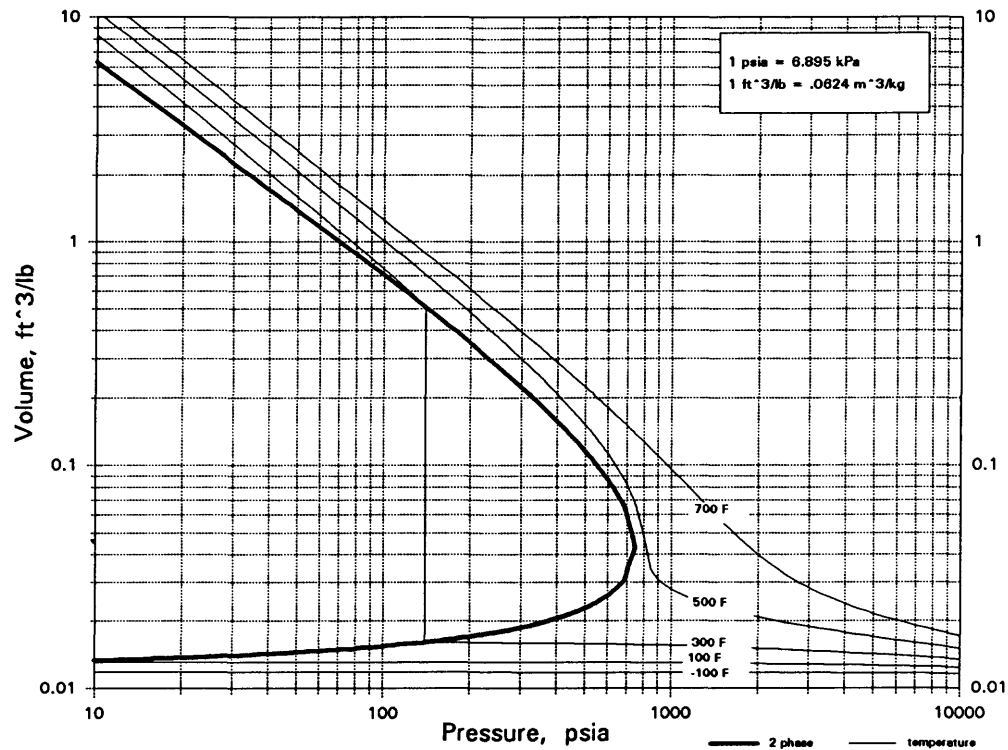
C2H2Cl2

1-1-DICHLOROETHYLENE



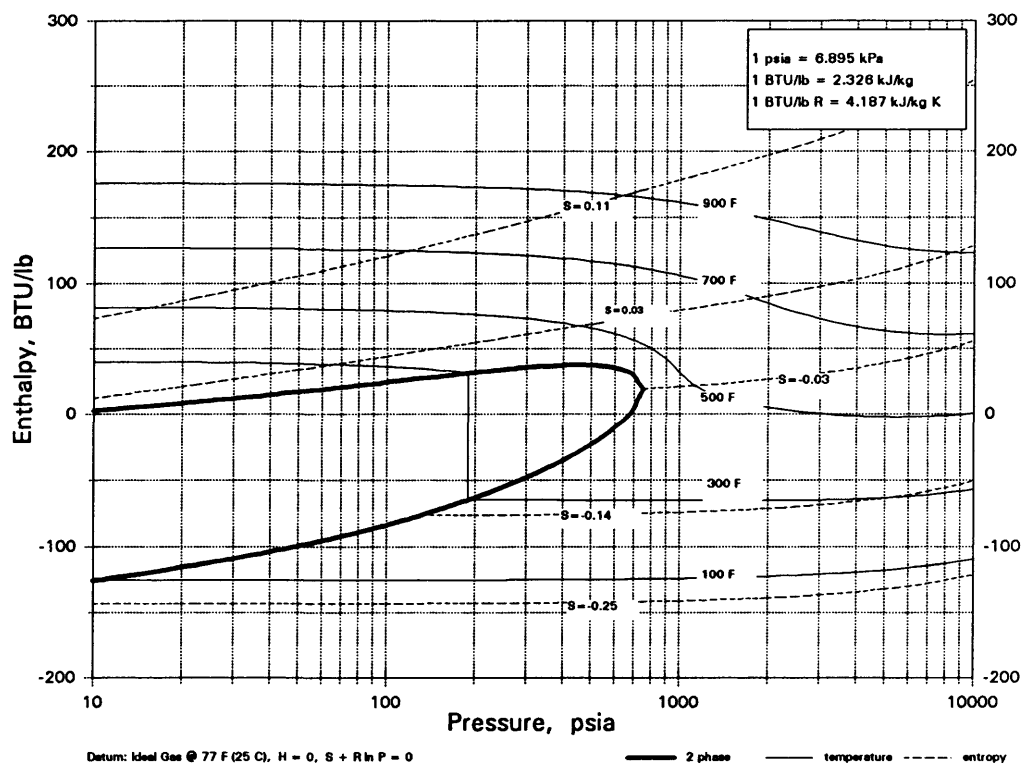
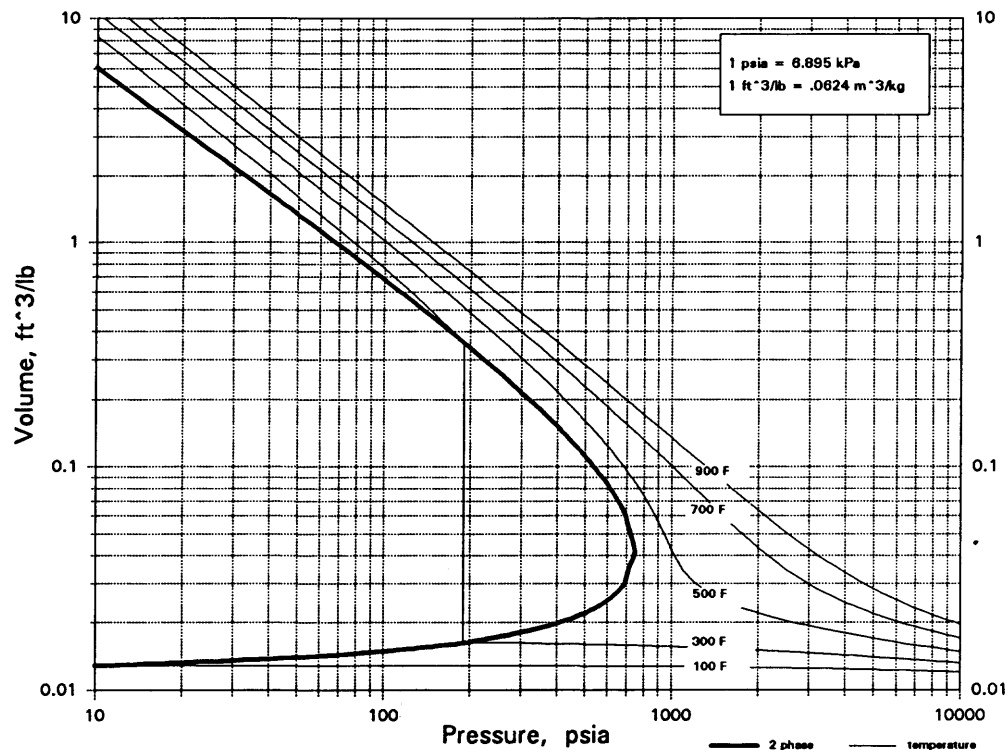
C₂H₂Cl₂

cis-1-2-DICHLOROETHYLENE



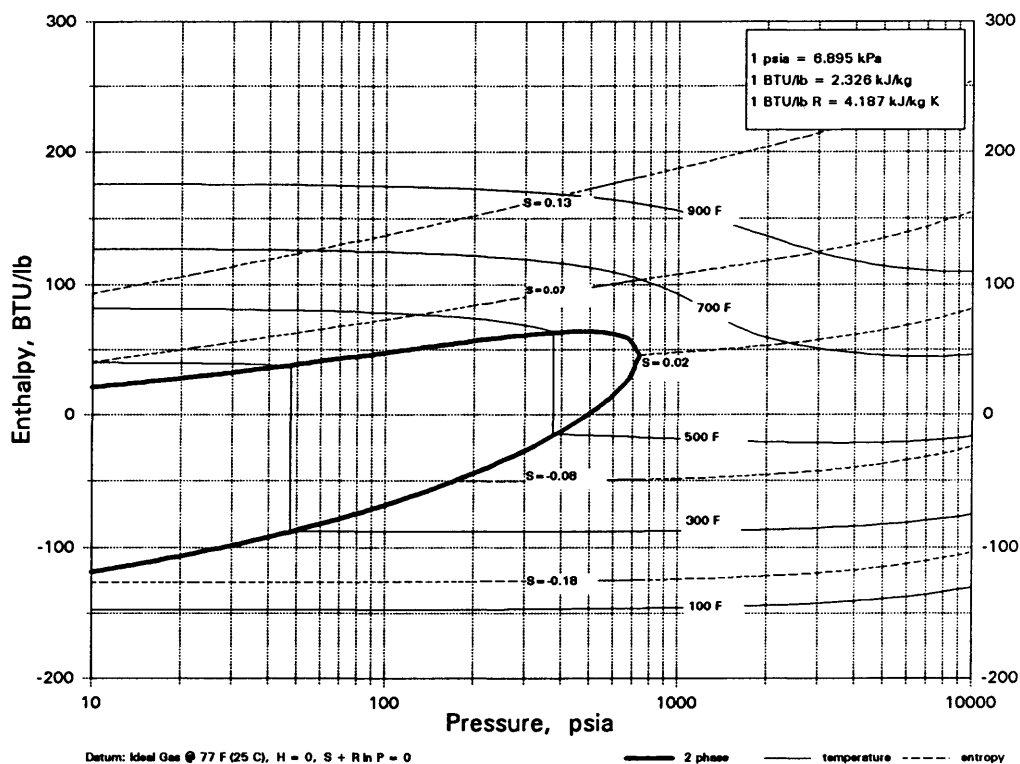
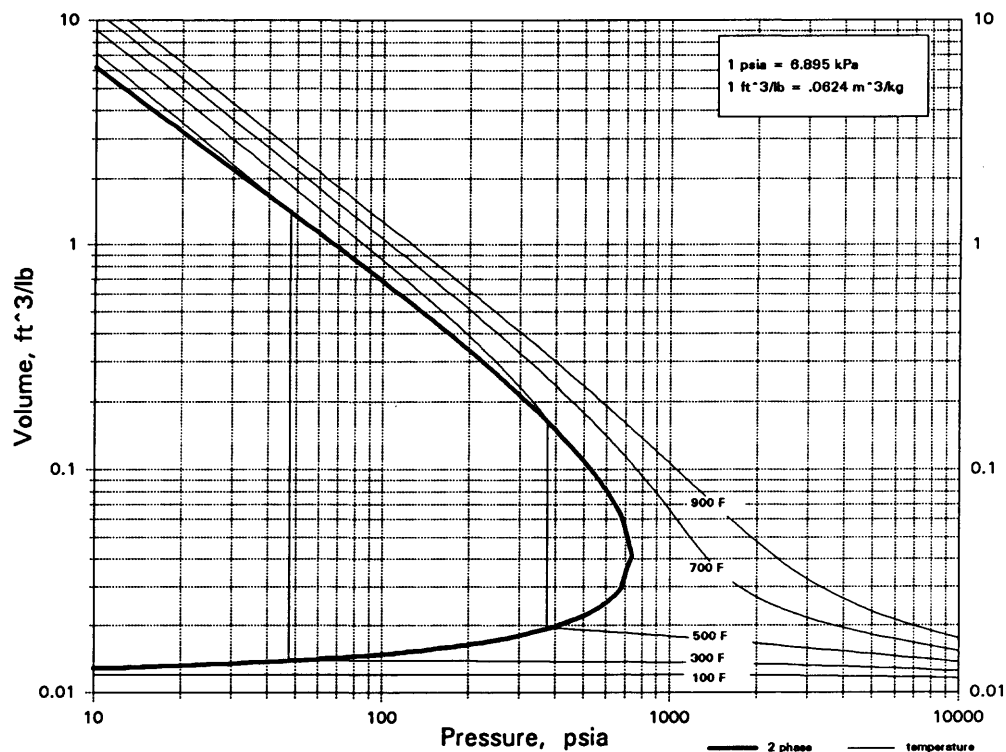
C2H2Cl2

trans-1-2-DICHLOROETHYLENE



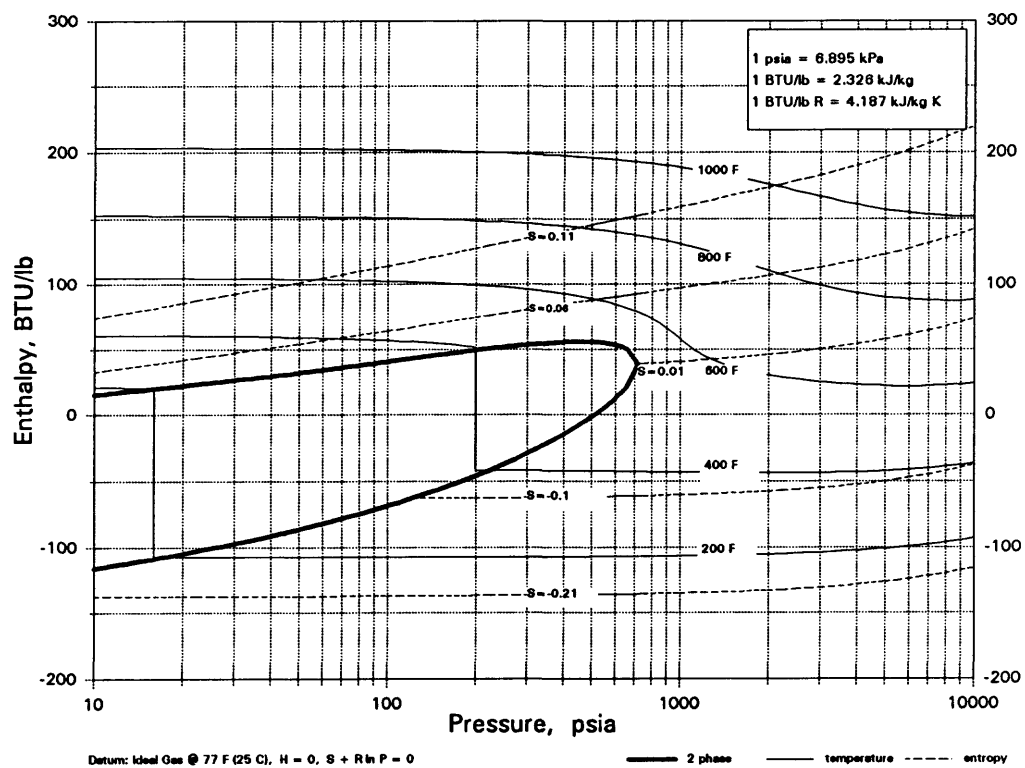
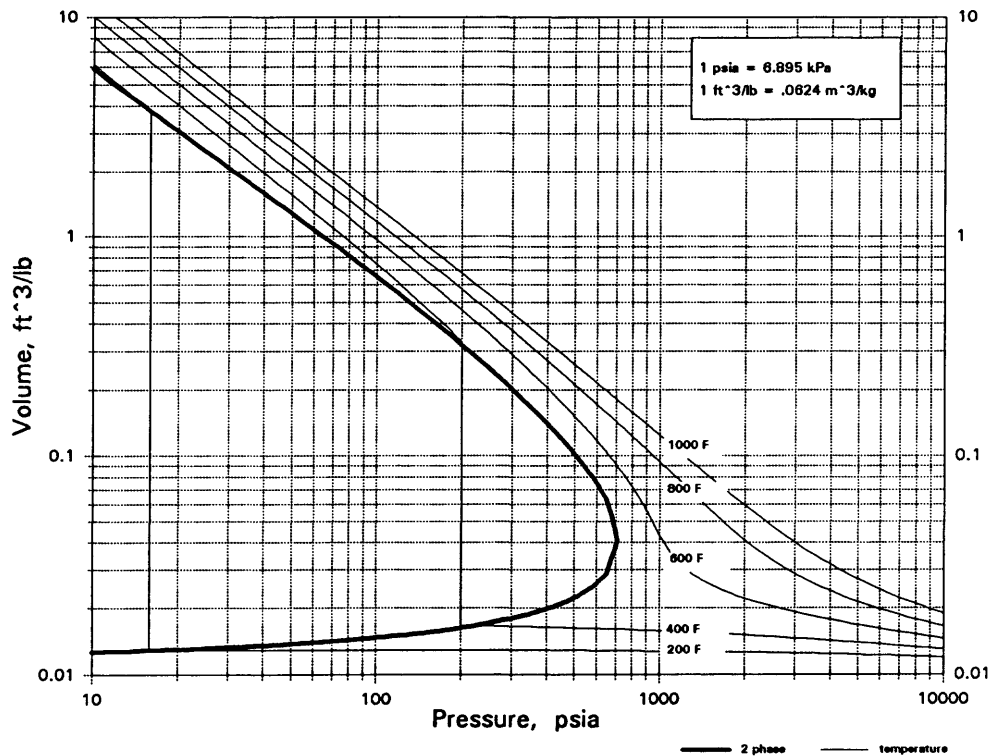
C₂H₂Cl₂O

CHLOROACETYL CHLORIDE

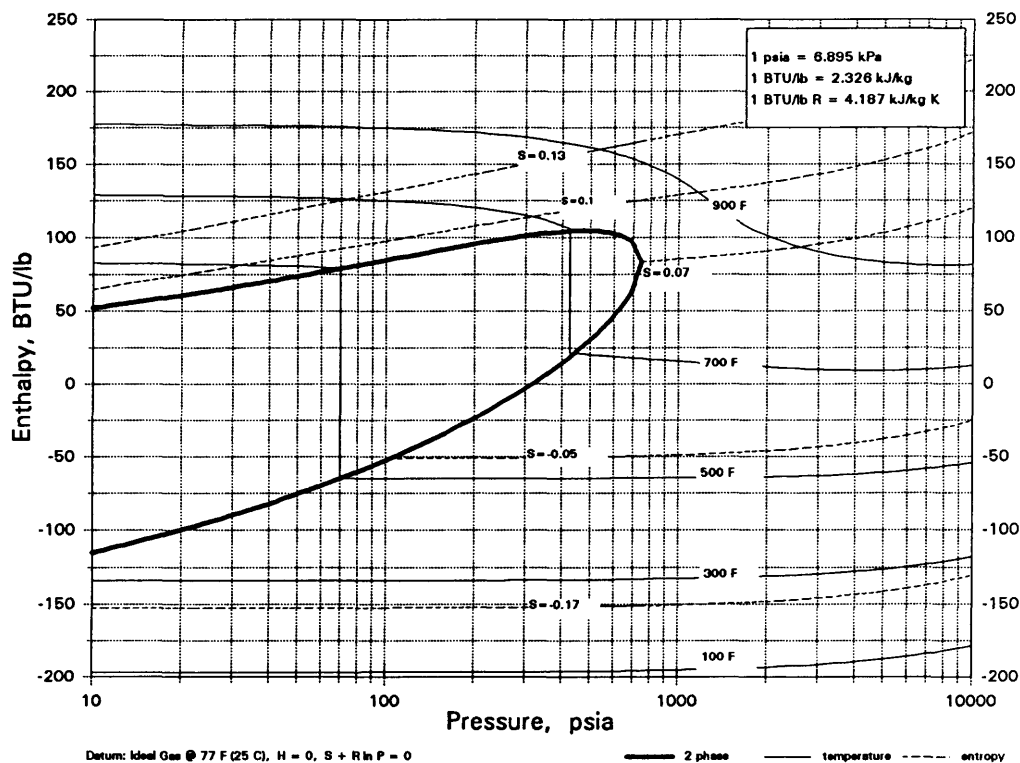
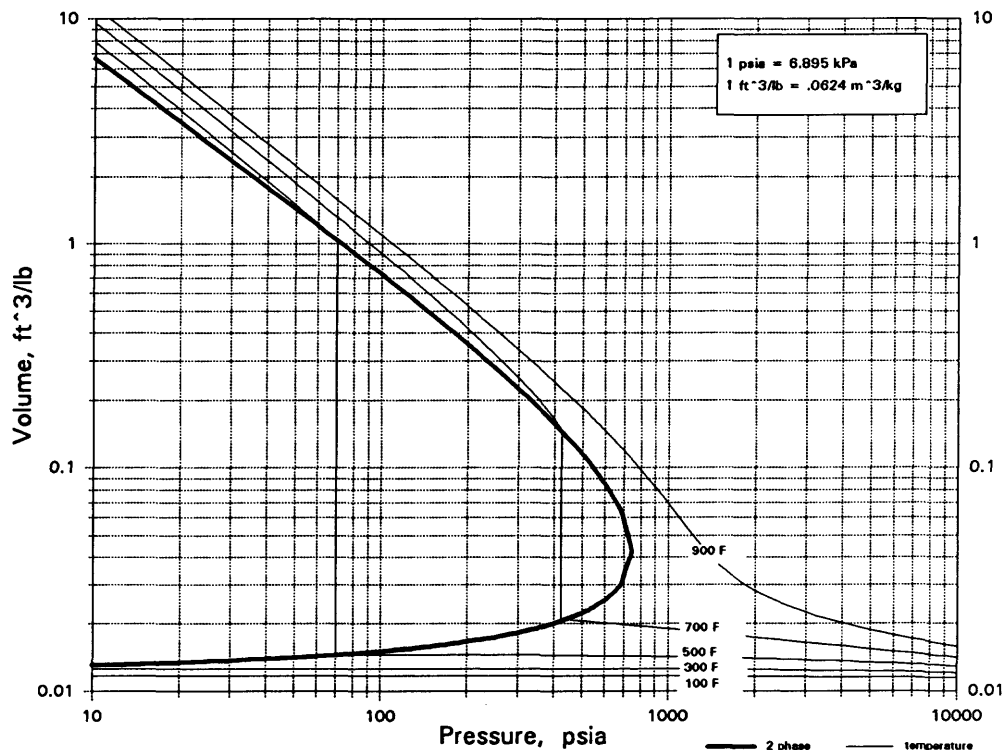


C₂H₂Cl₂O

DICHLOROACETALDEHYDE

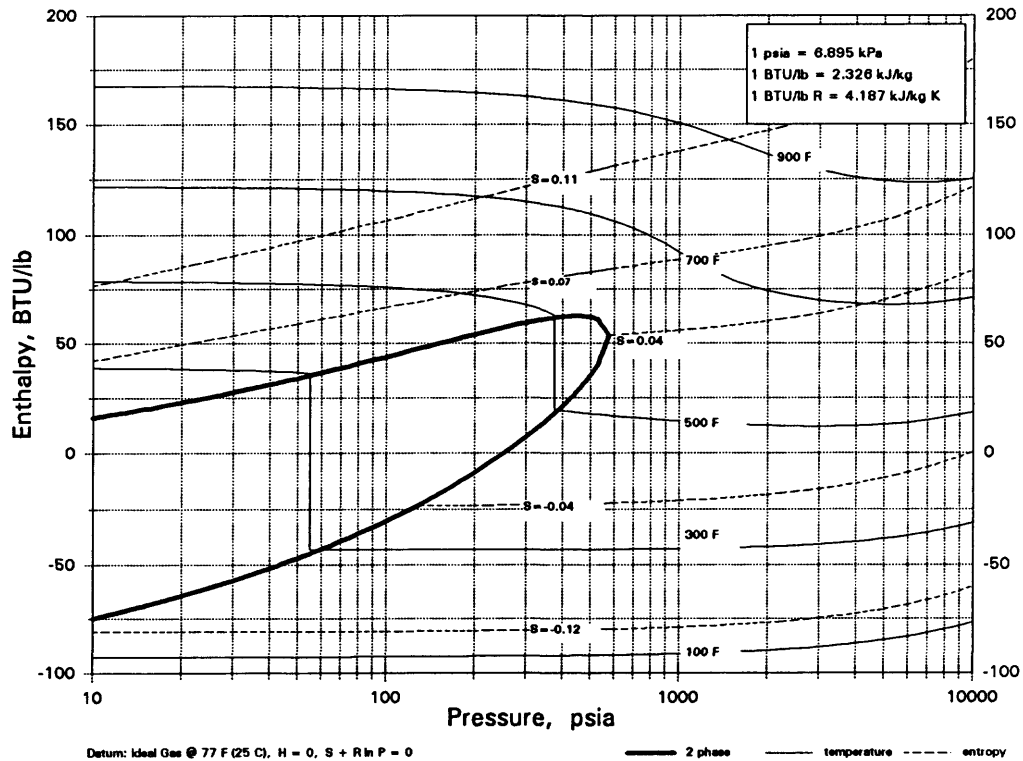
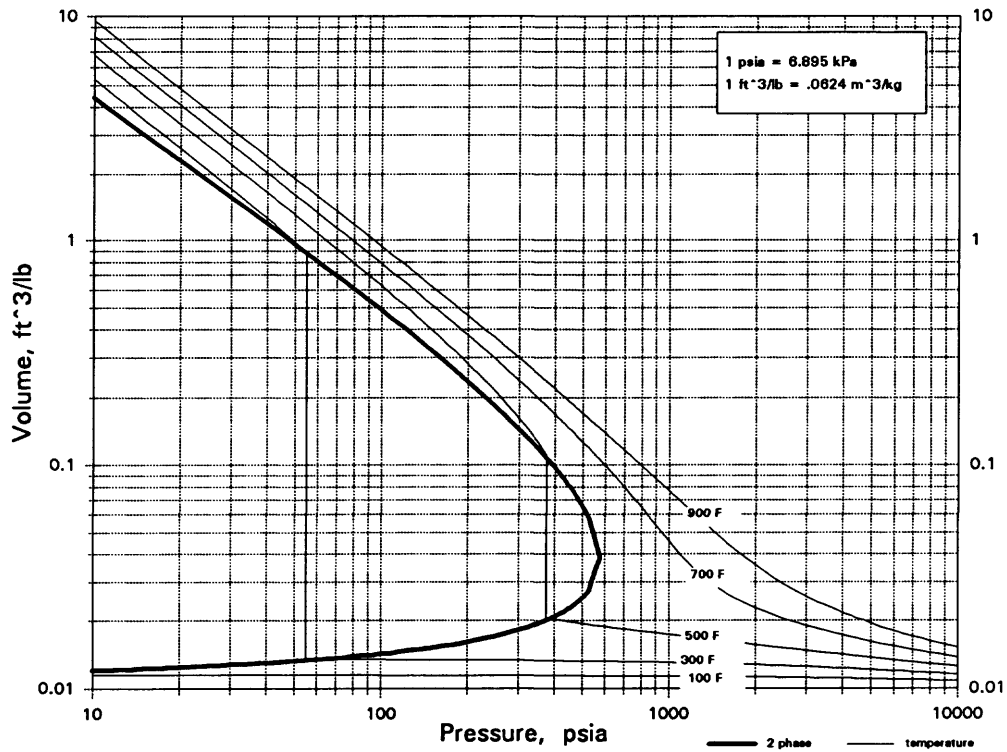


C₂H₂Cl₂O₂ DICHLOROACETIC ACID



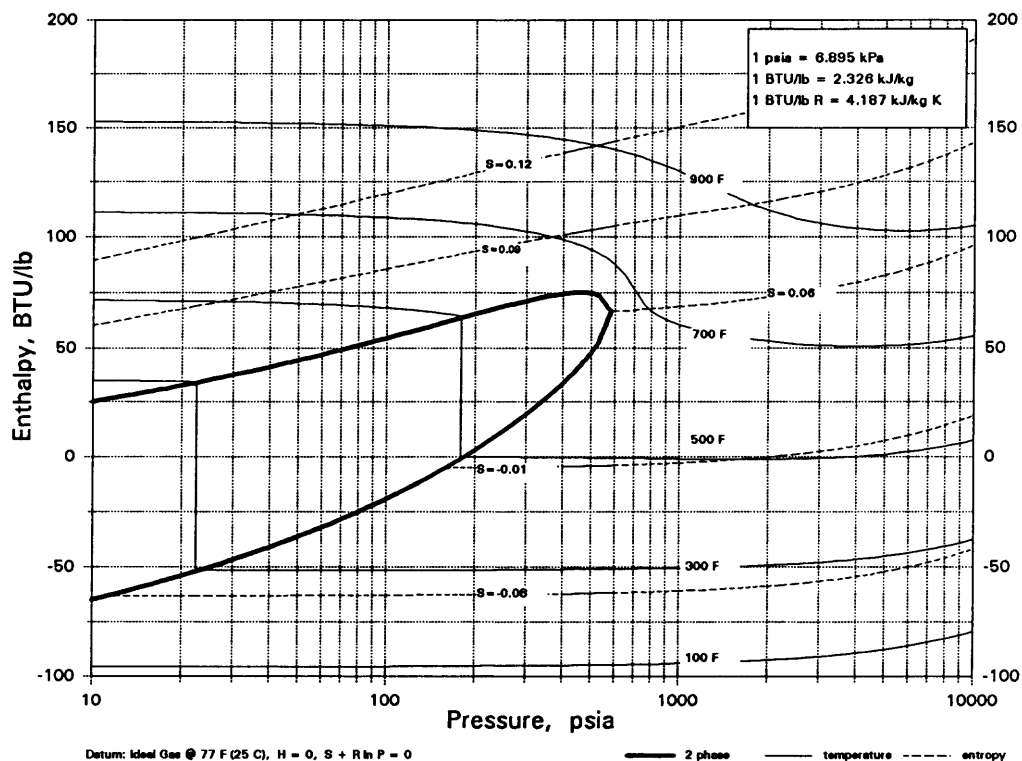
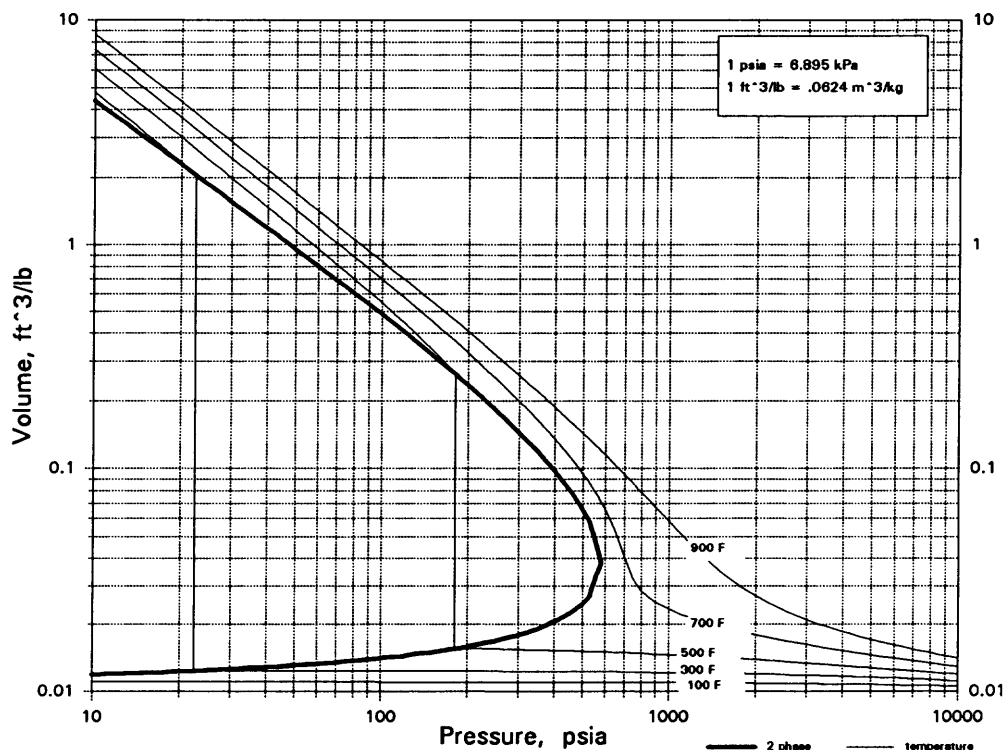
C₂H₂Cl₃F

1-1-1-TRICHLOROFLUOROETHANE



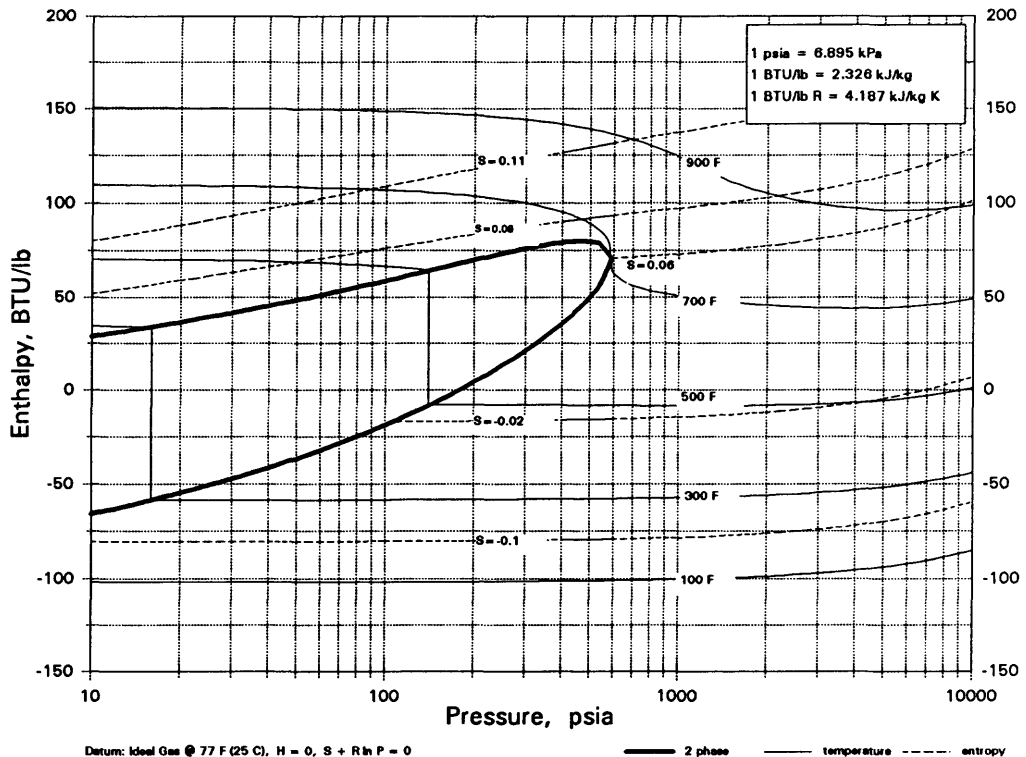
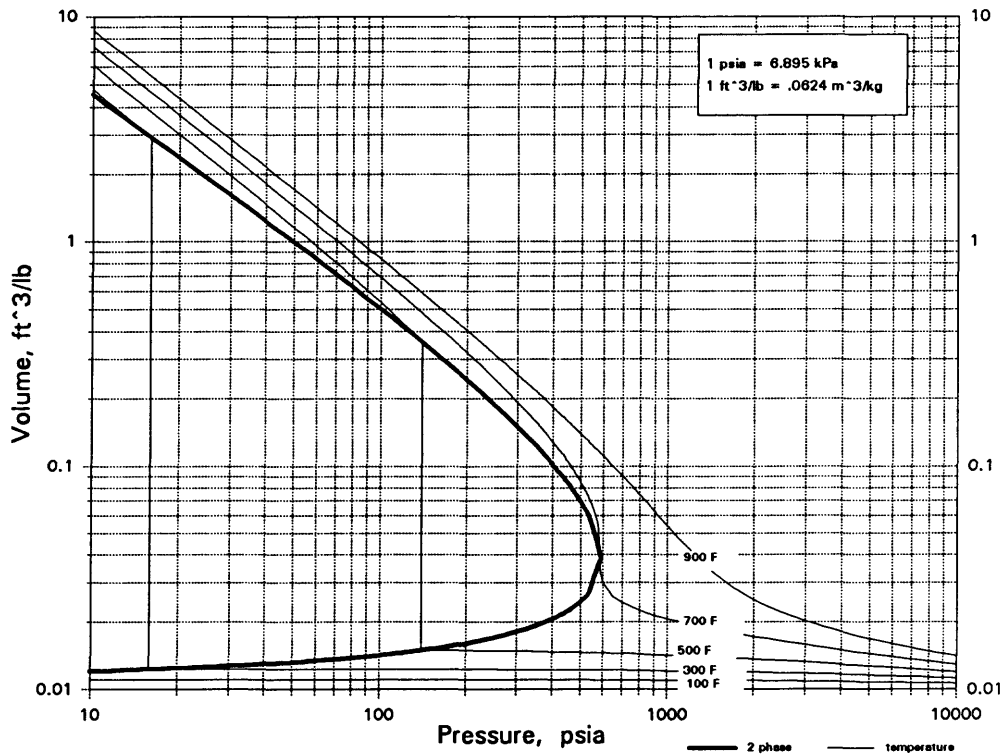
C₂H₂Cl₄

1-1-1-2-TETRACHLOROETHANE



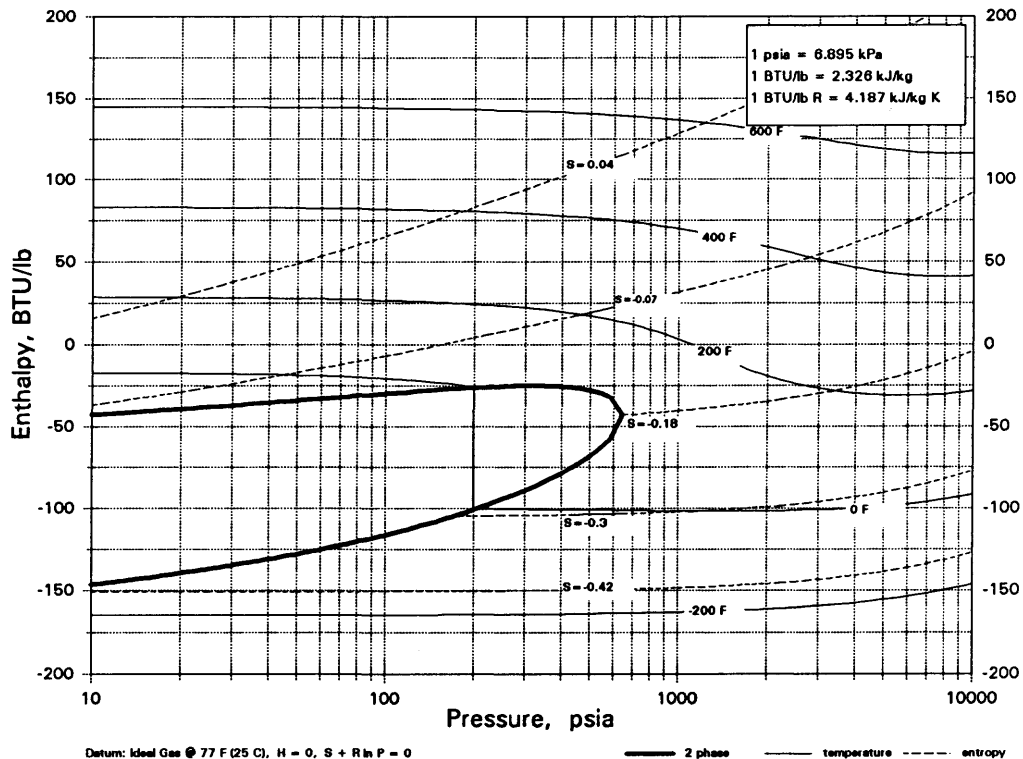
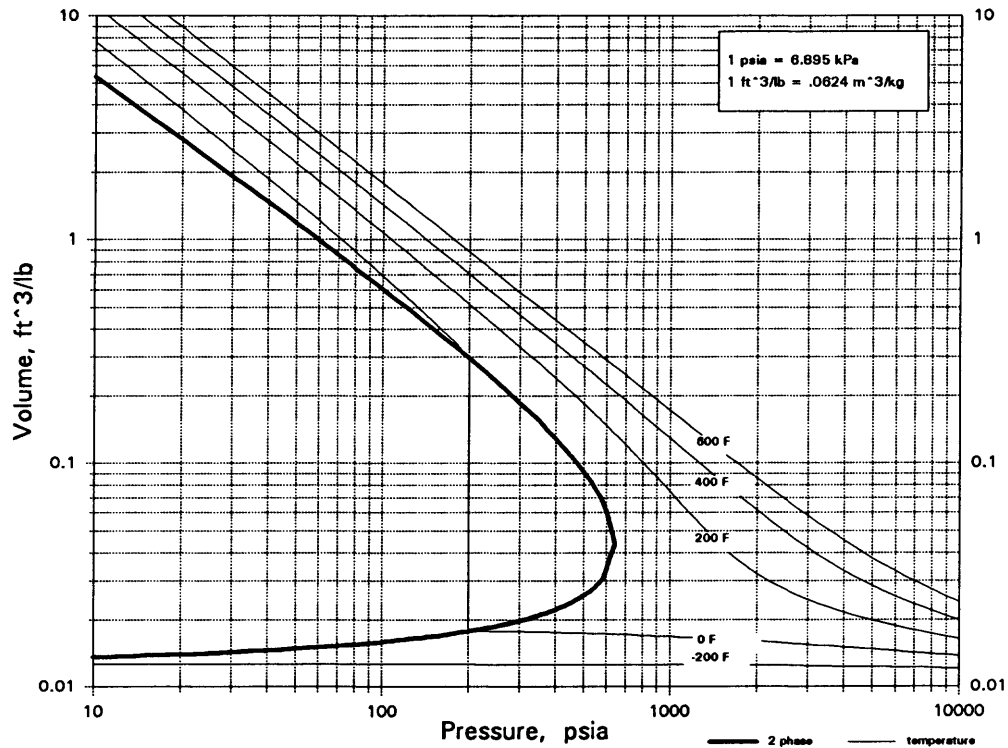
C₂H₂Cl₄

1-1-2-2-TETRACHLOROETHANE



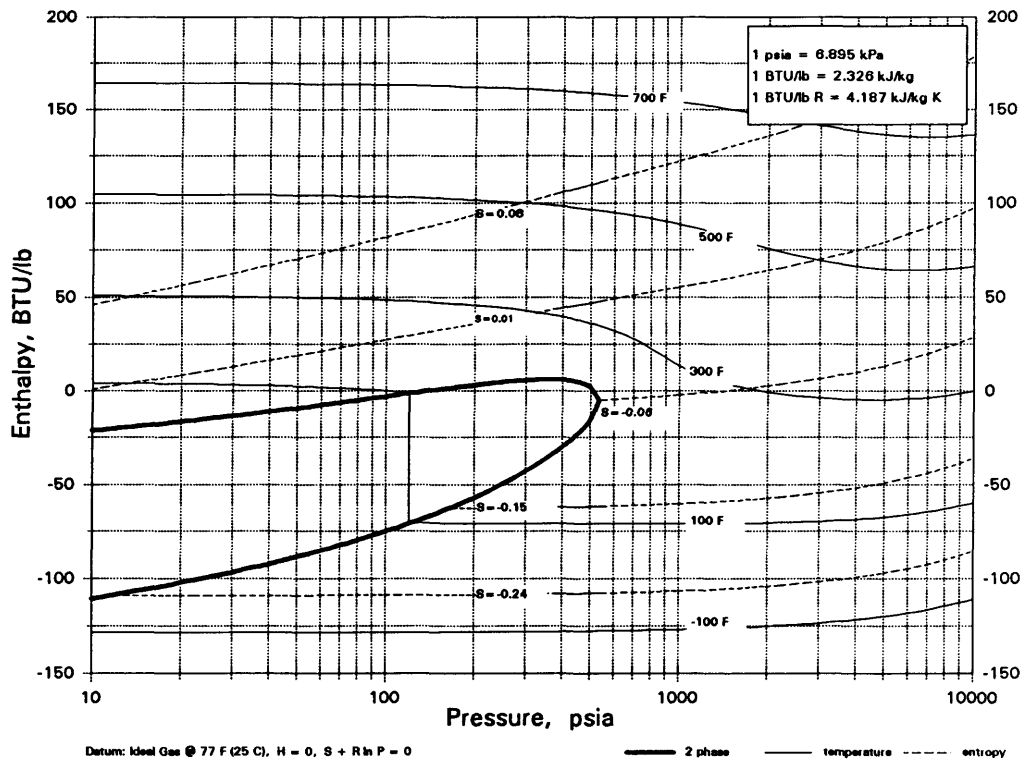
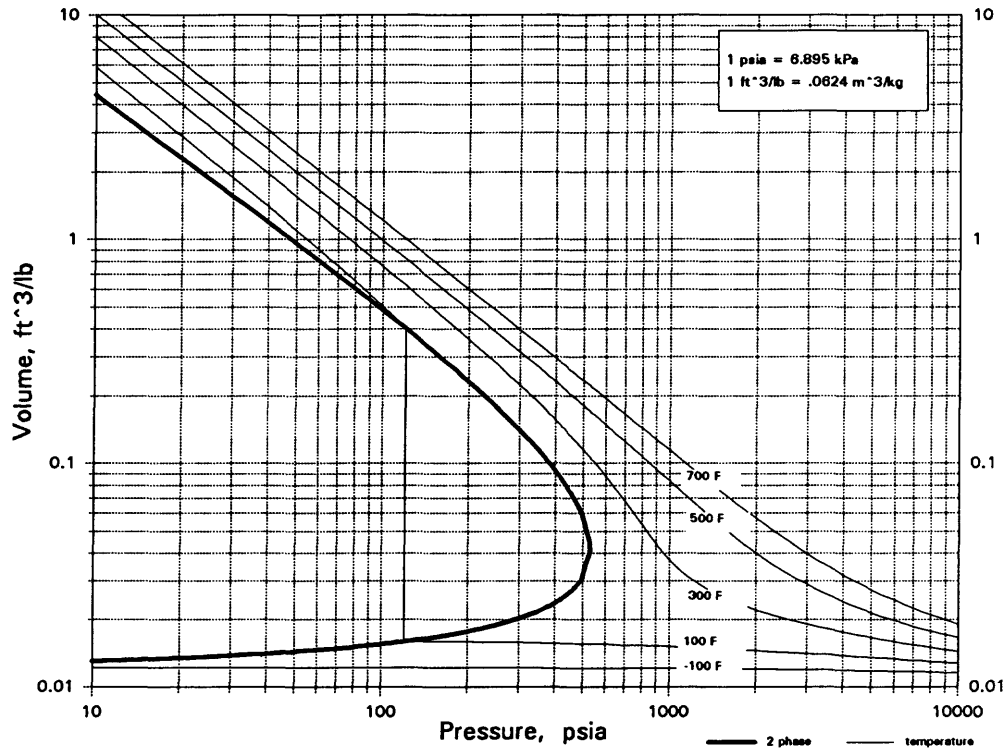
C2H2F2

1-1-DIFLUOROETHYLENE

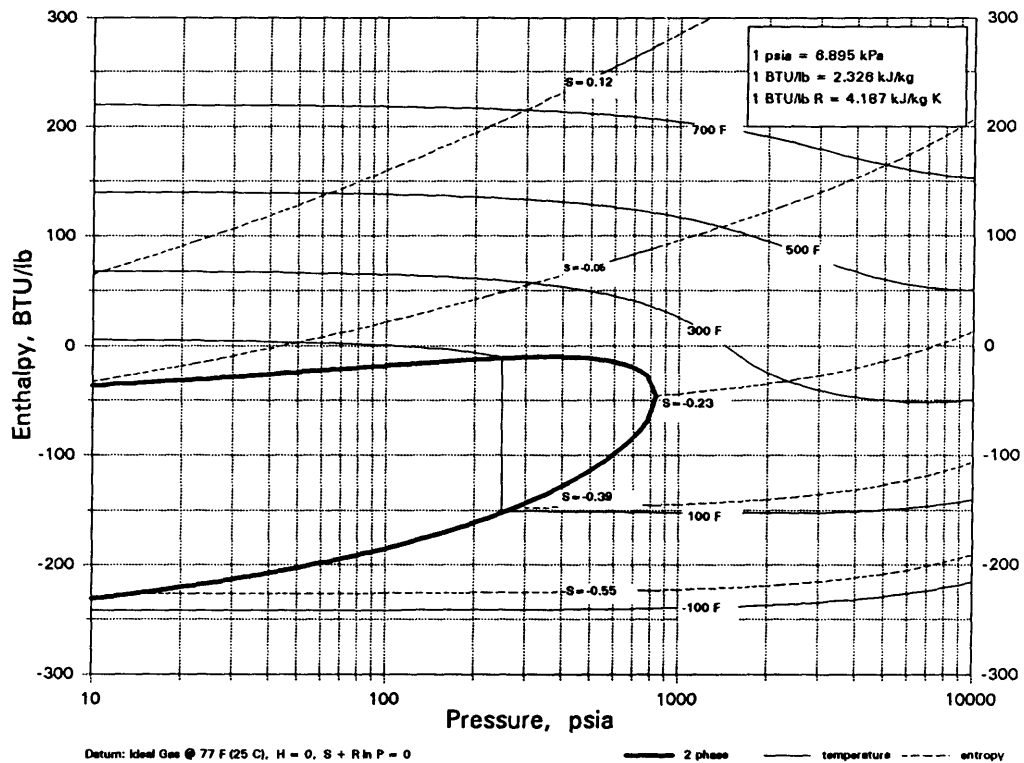
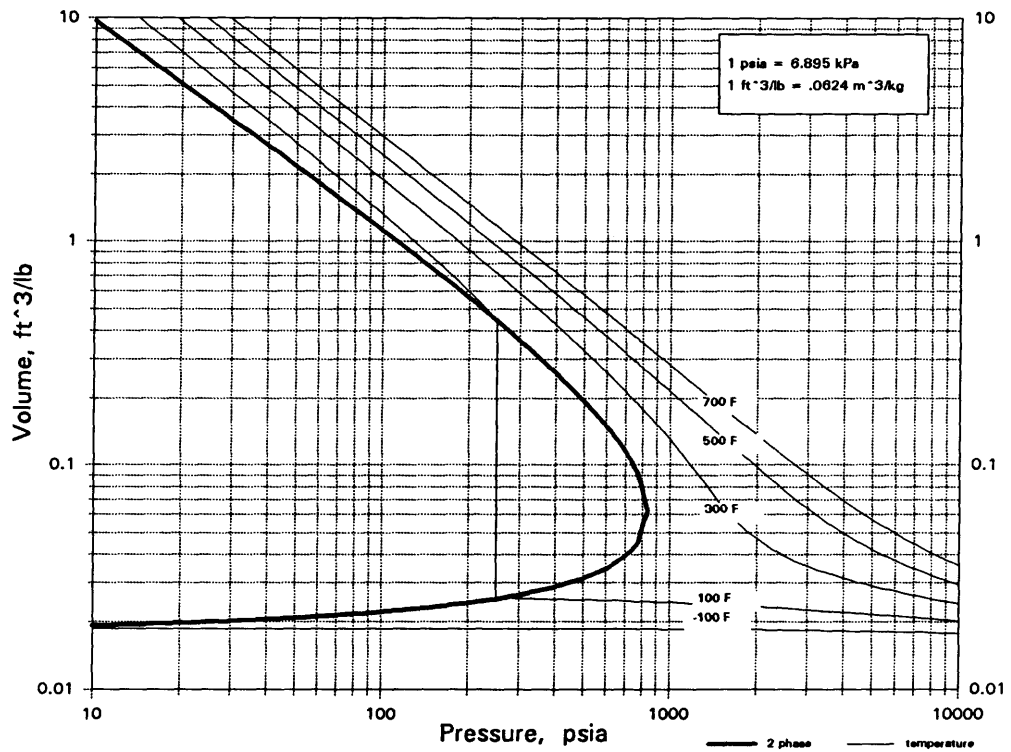


C2H2F4

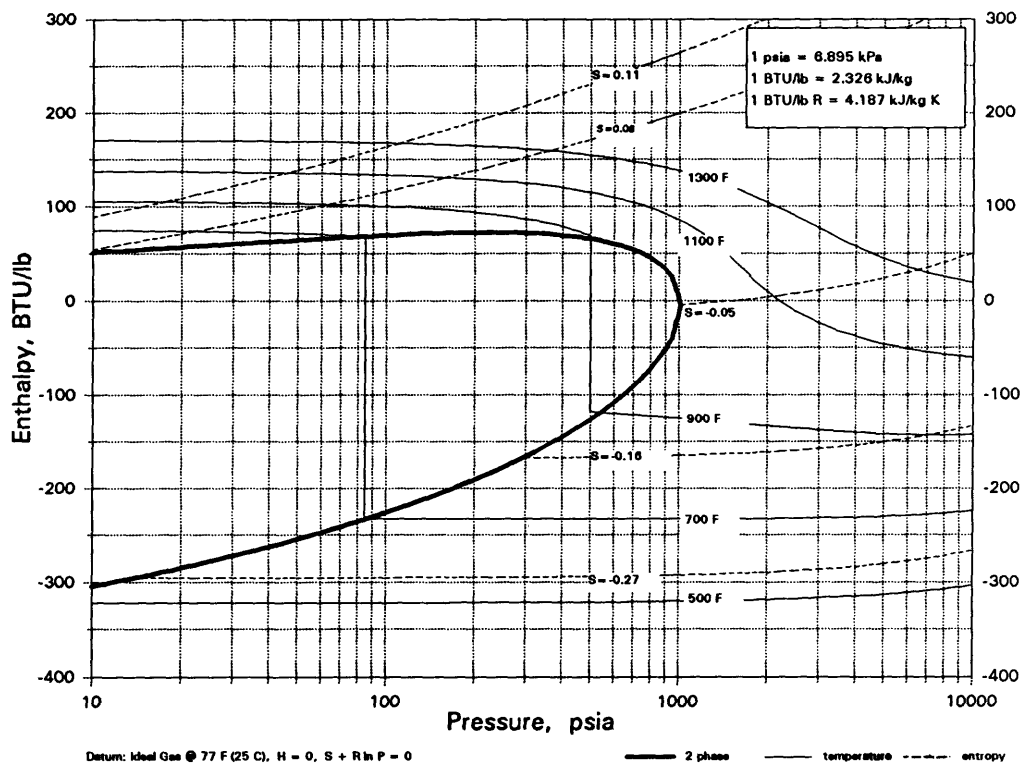
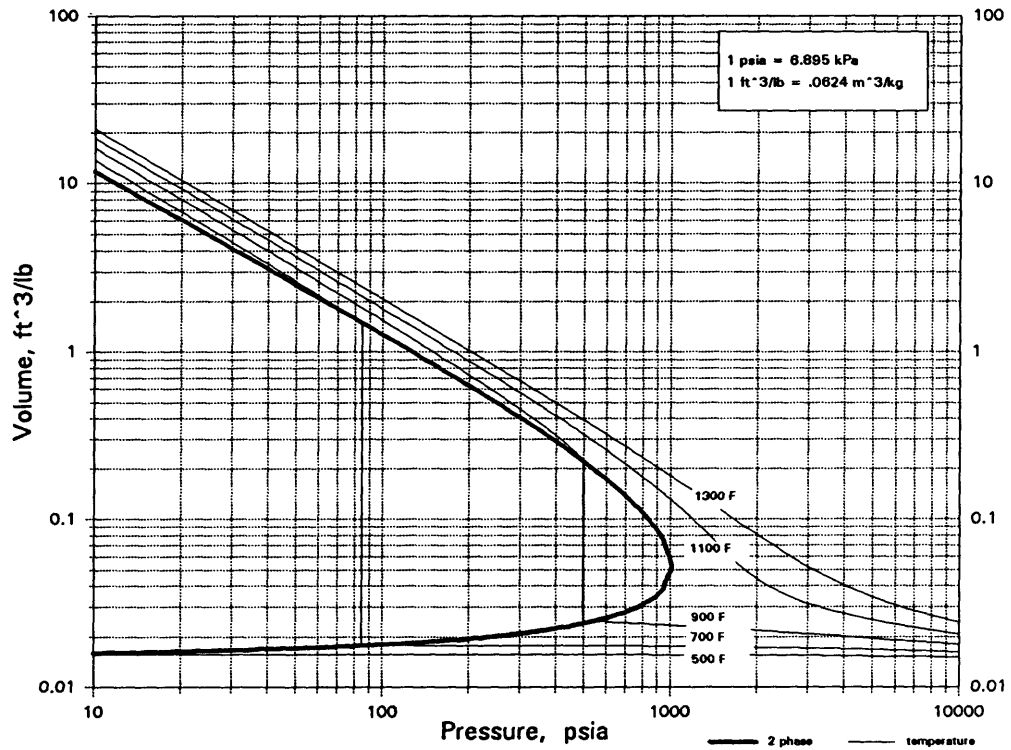
1-1-1-2-TETRAFLUOROETHANE



C2H2O
KETENE

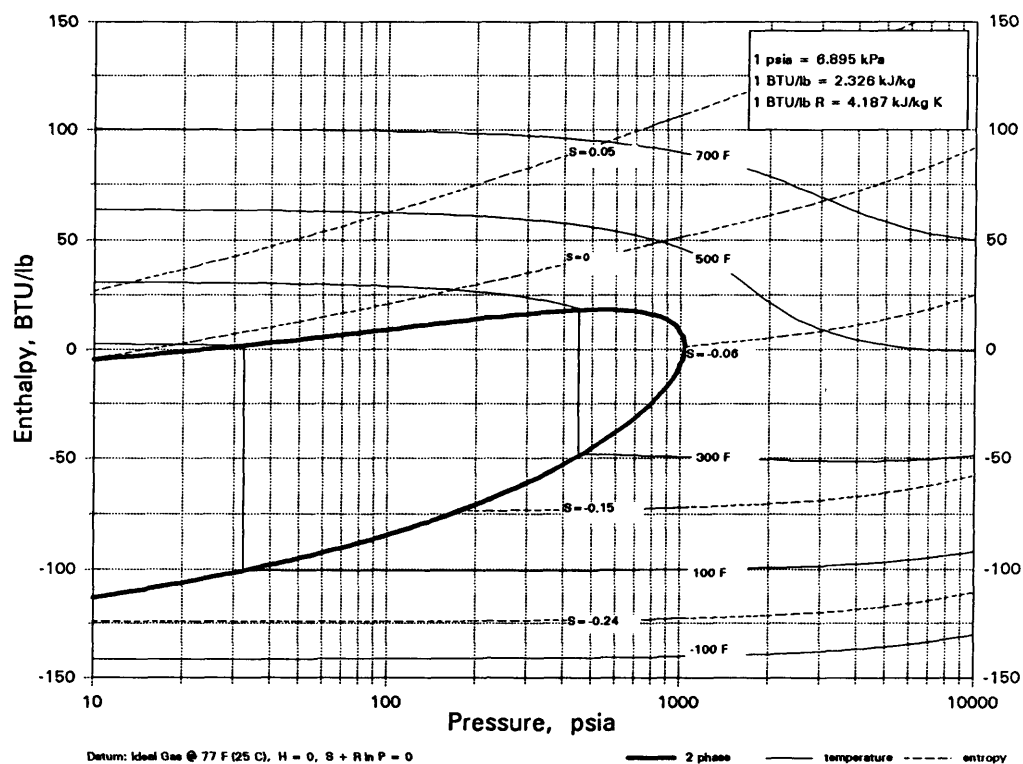
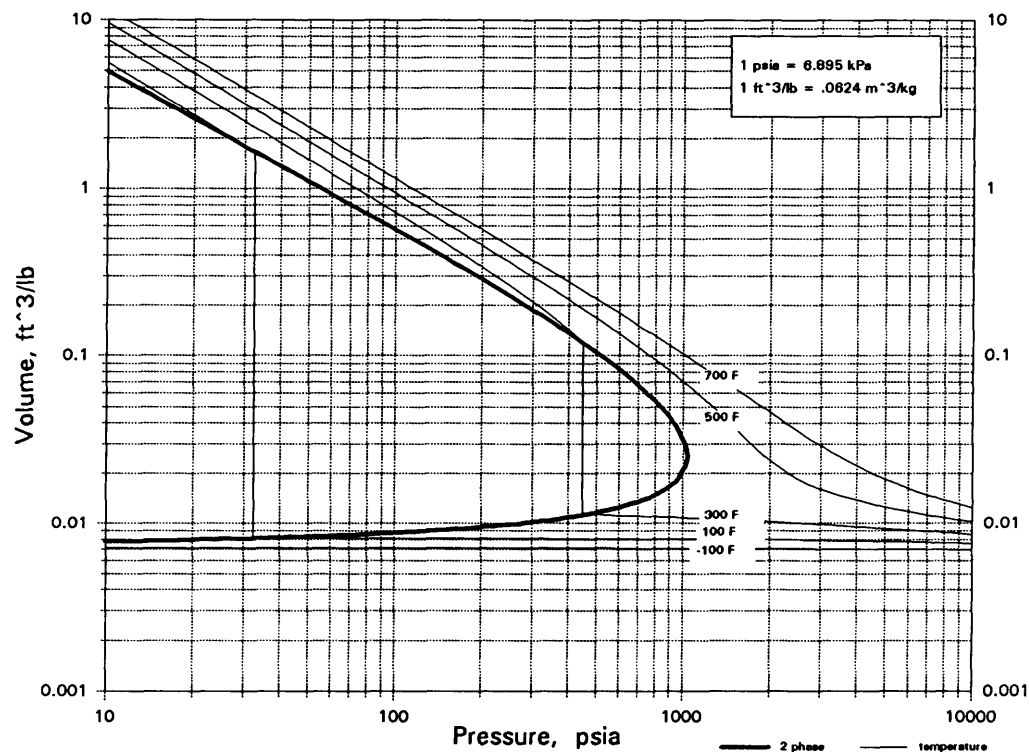


C₂H₂O₄
OXALIC ACID



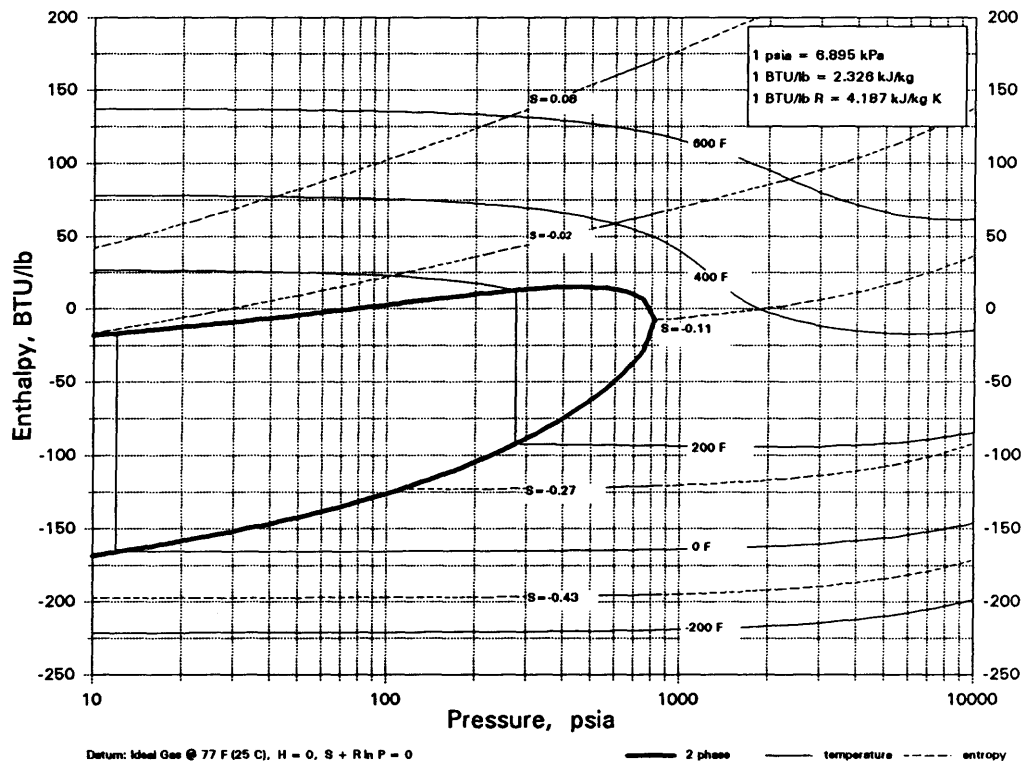
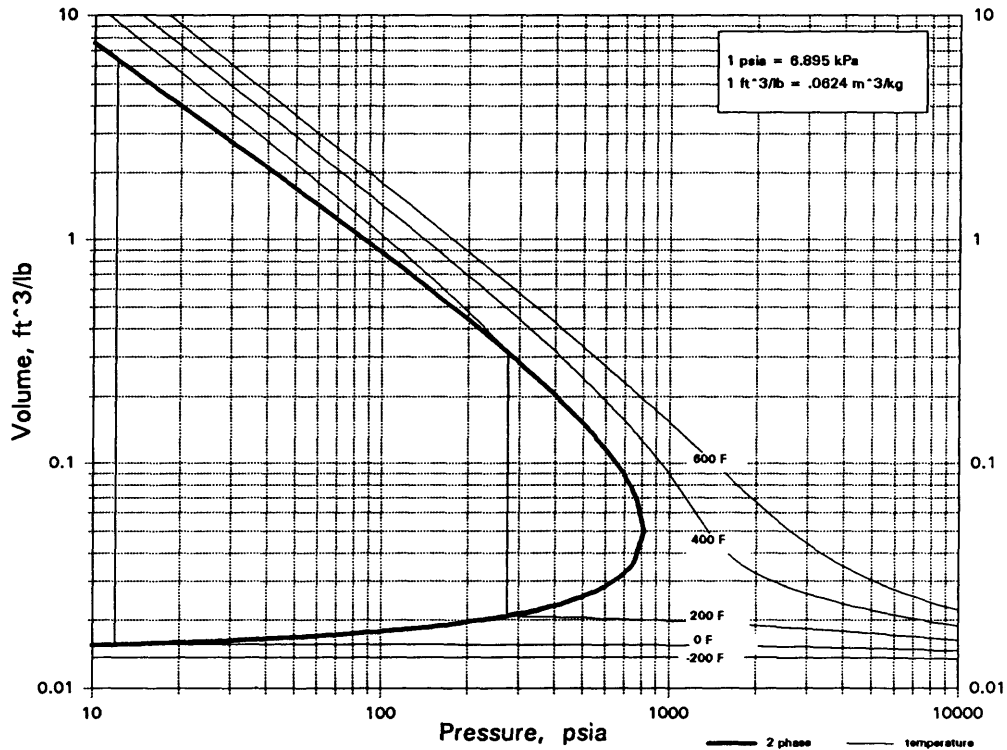
C₂H₃Br

VINYL BROMIDE



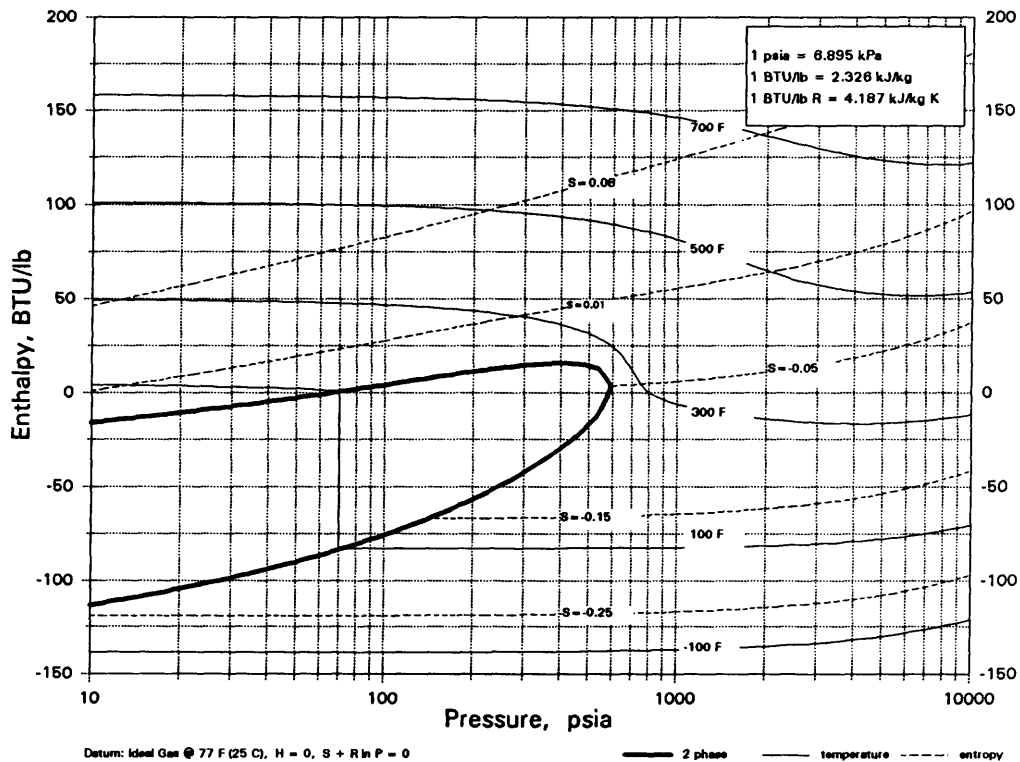
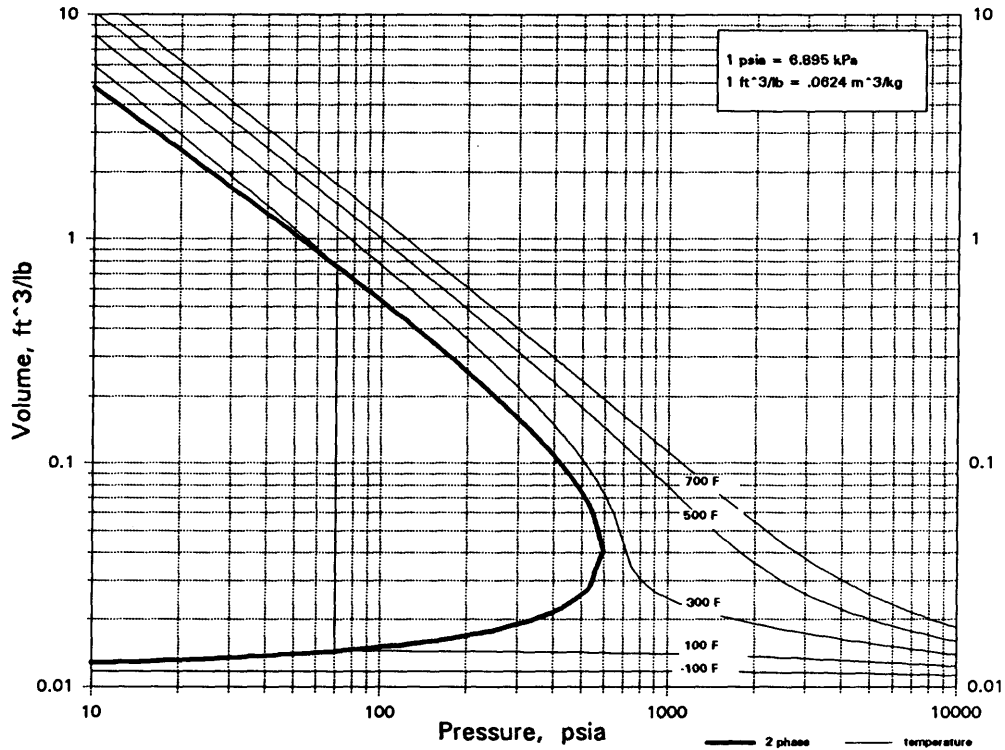
C₂H₃Cl

VINYL CHLORIDE



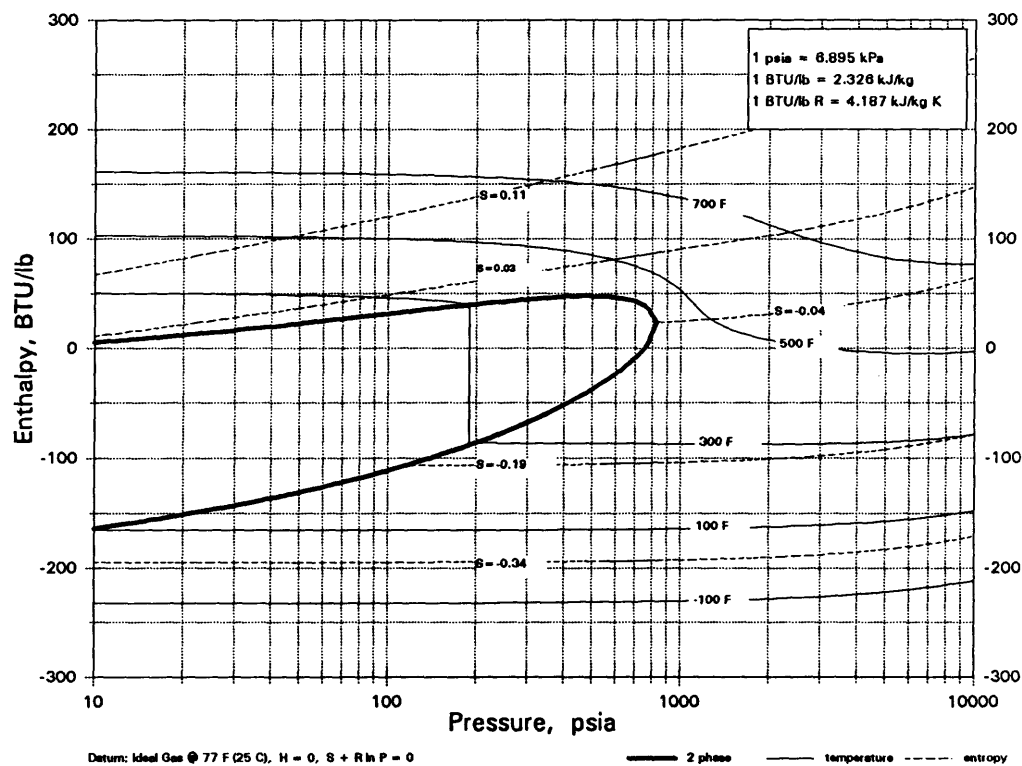
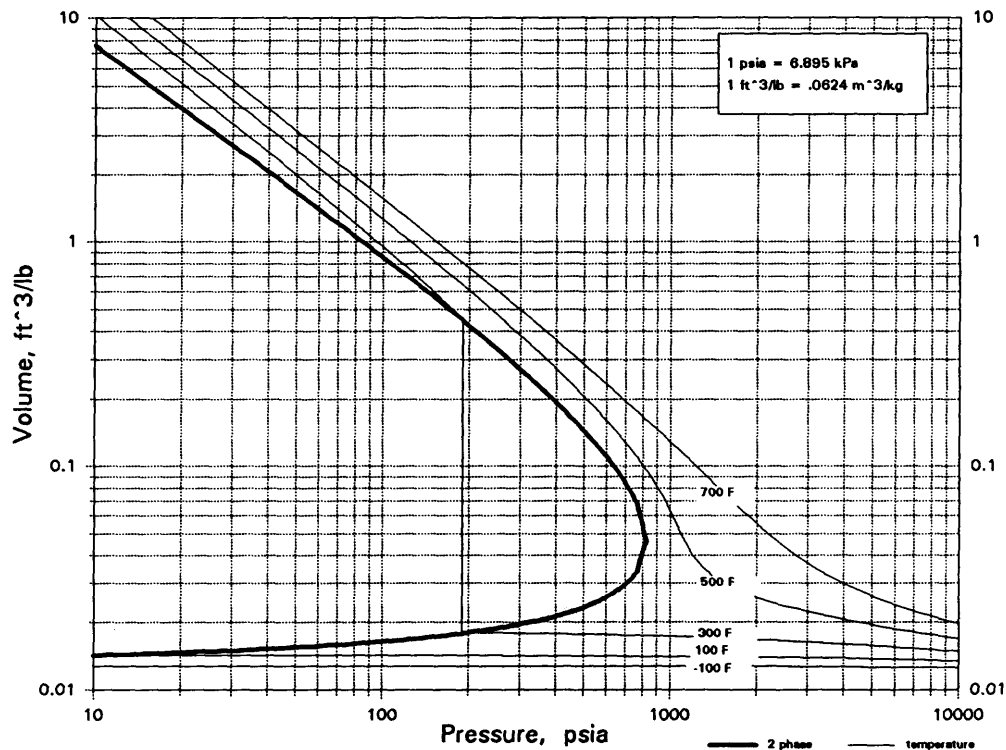
C2H3ClF2

1-CHLORO-1-1-DIFLUOROETHANE



C₂H₃ClO

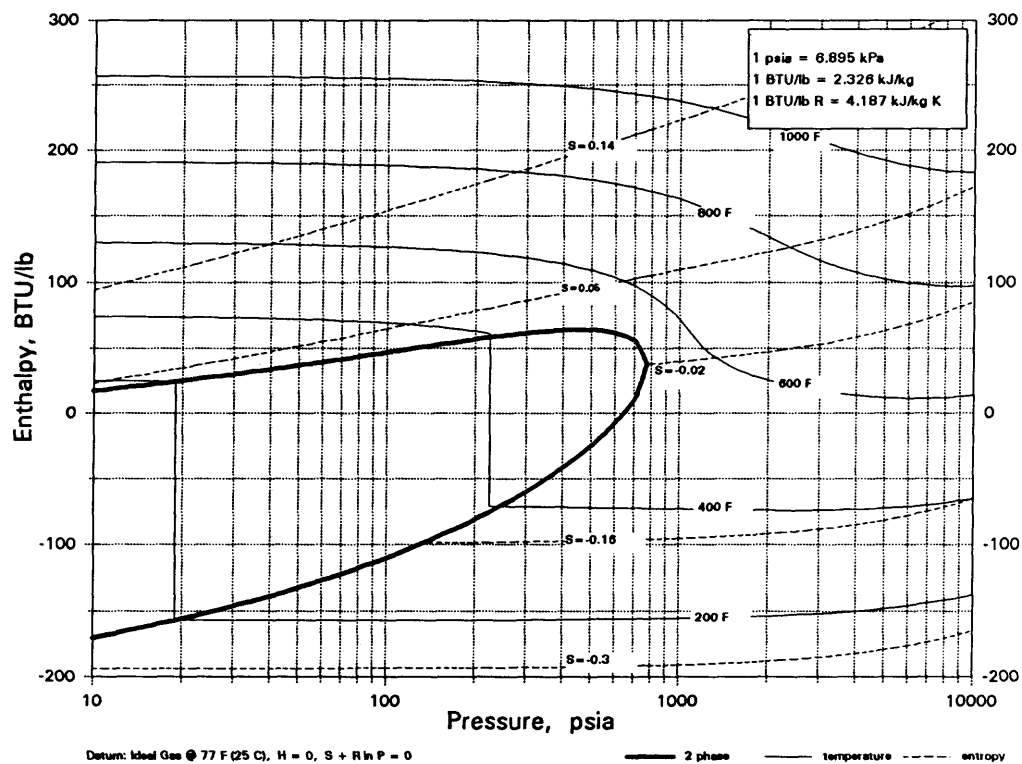
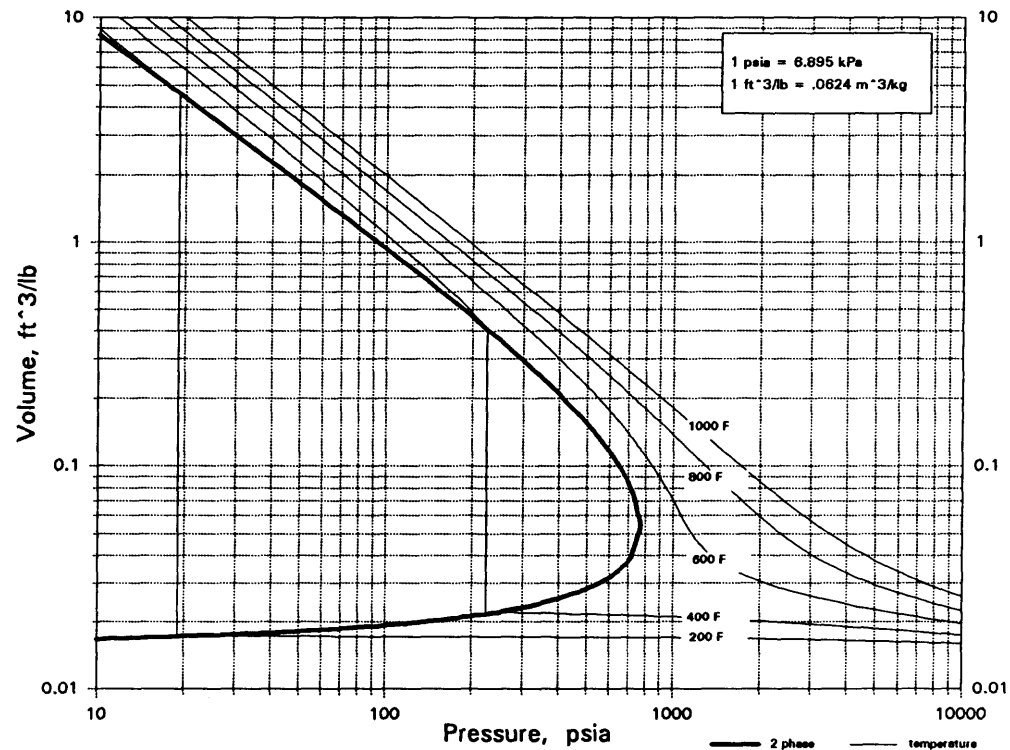
ACETYL CHLORIDE



Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

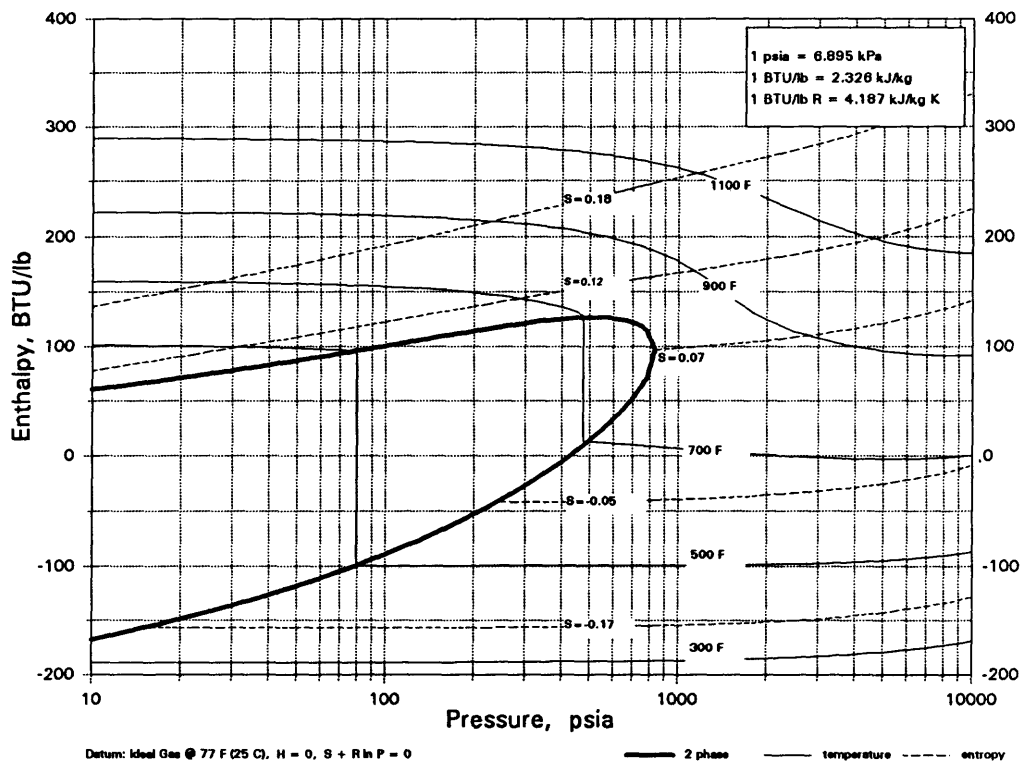
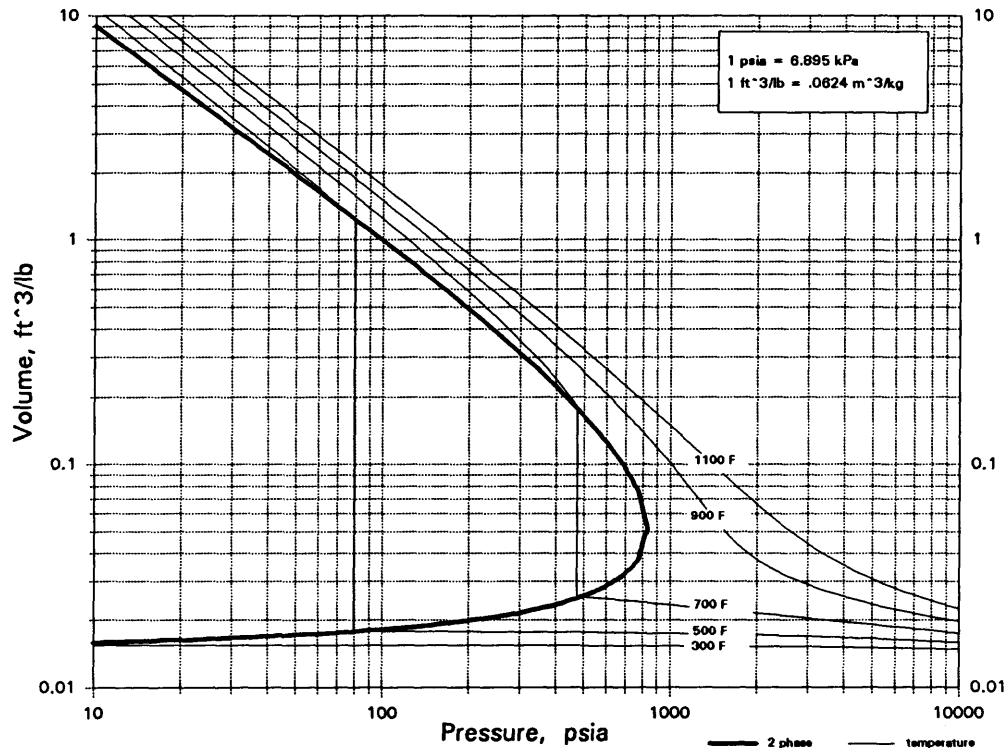
C2H3ClO

CHLOROACETALDEHYDE



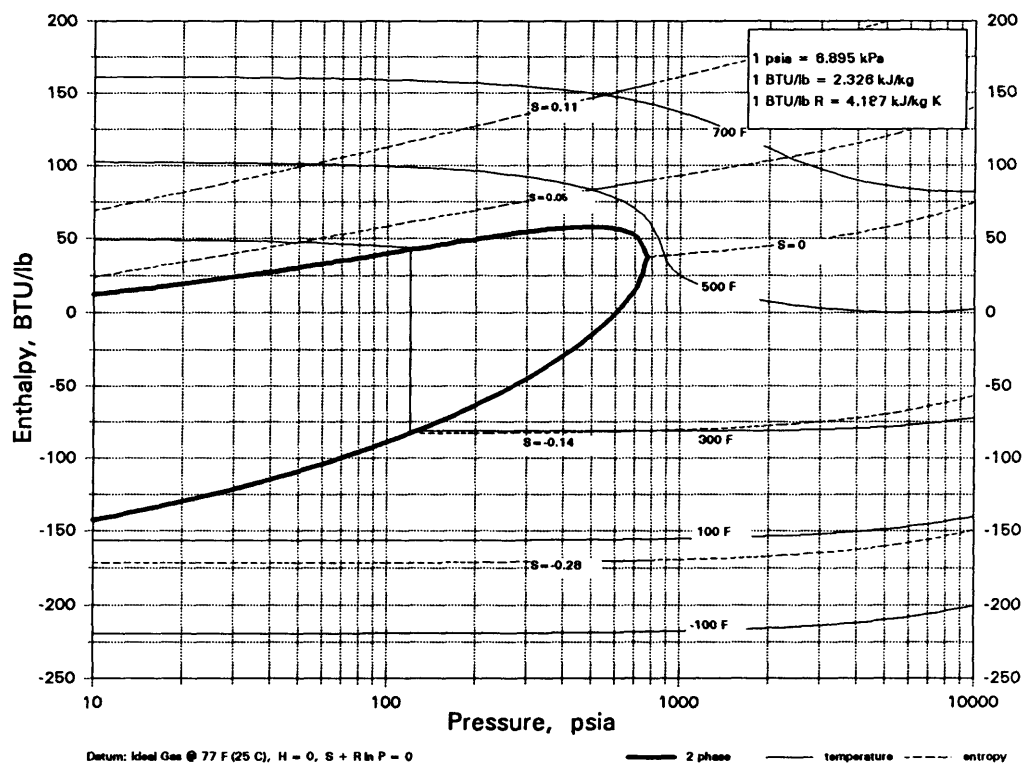
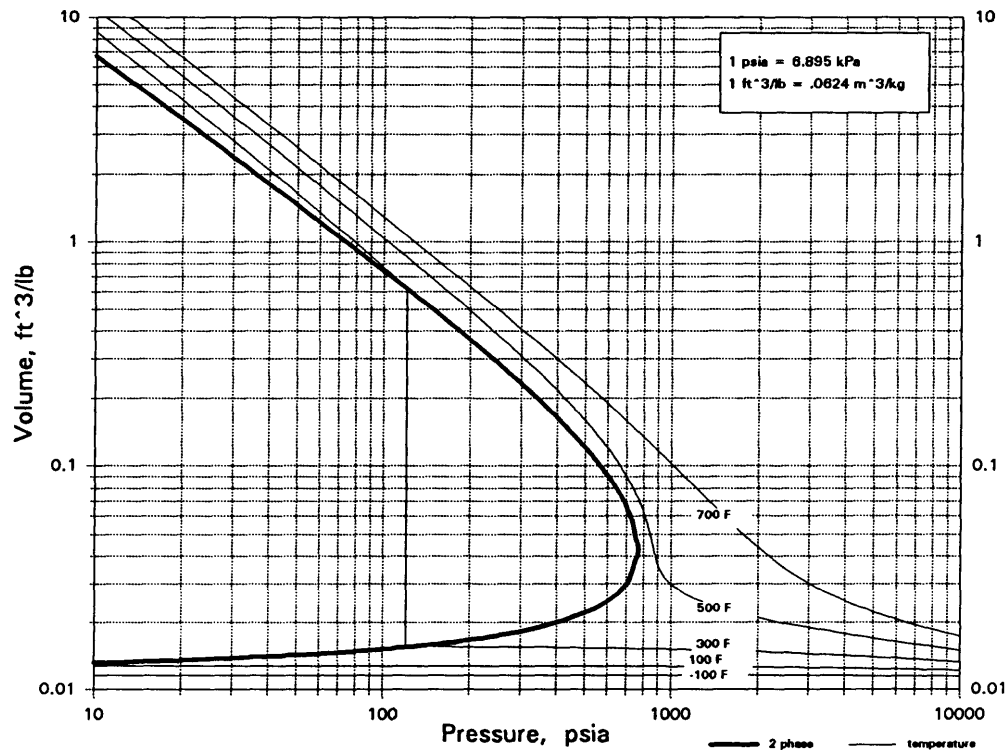
C2H3ClO2

CHLOROACETIC ACID



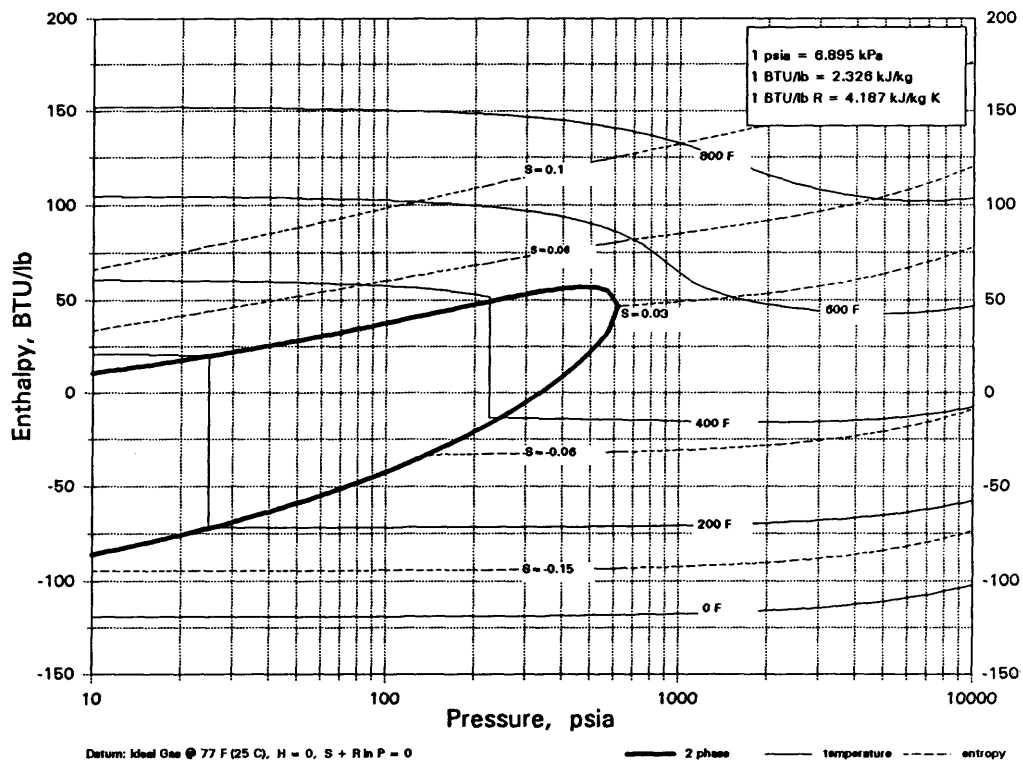
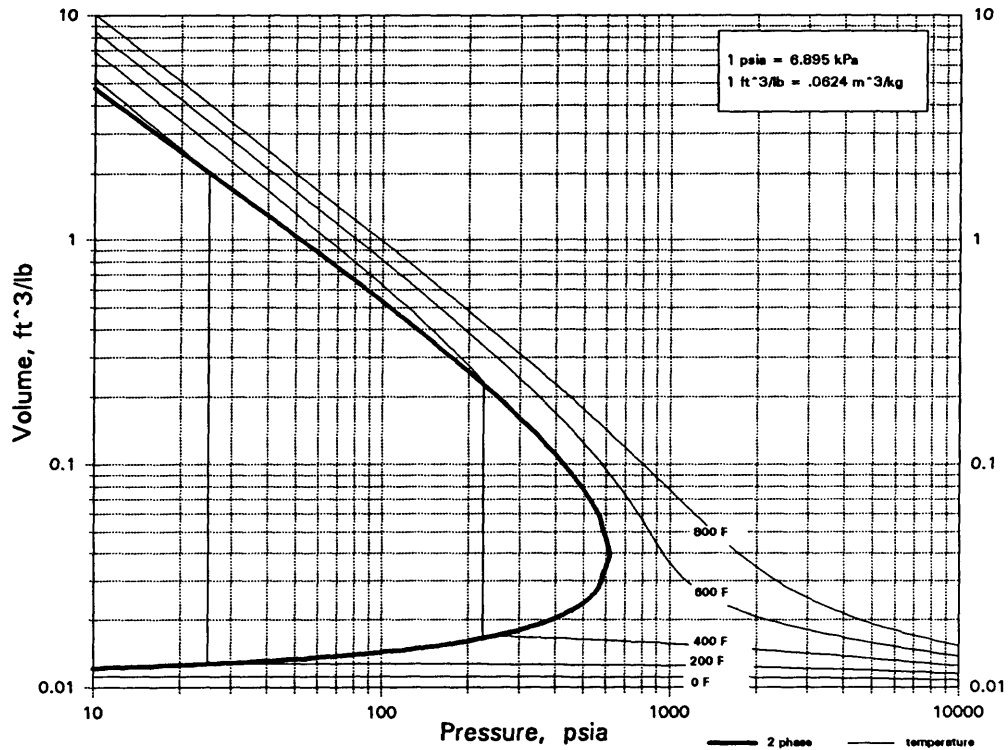
C2H3ClO2

METHYL CHLOROFORMATE



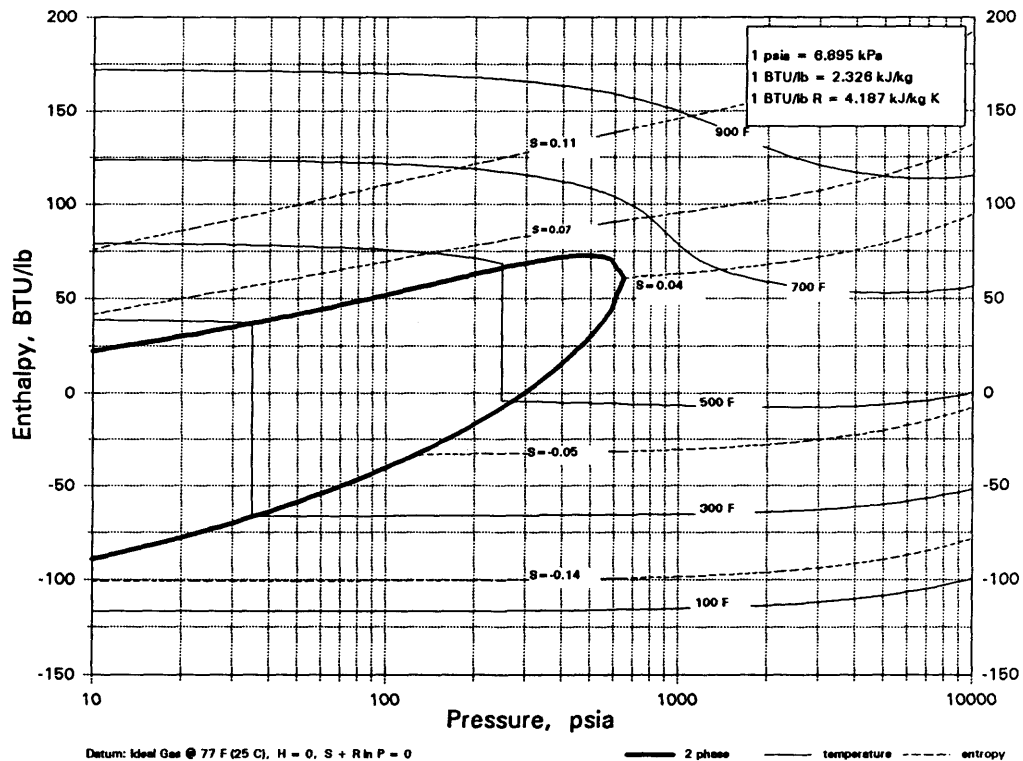
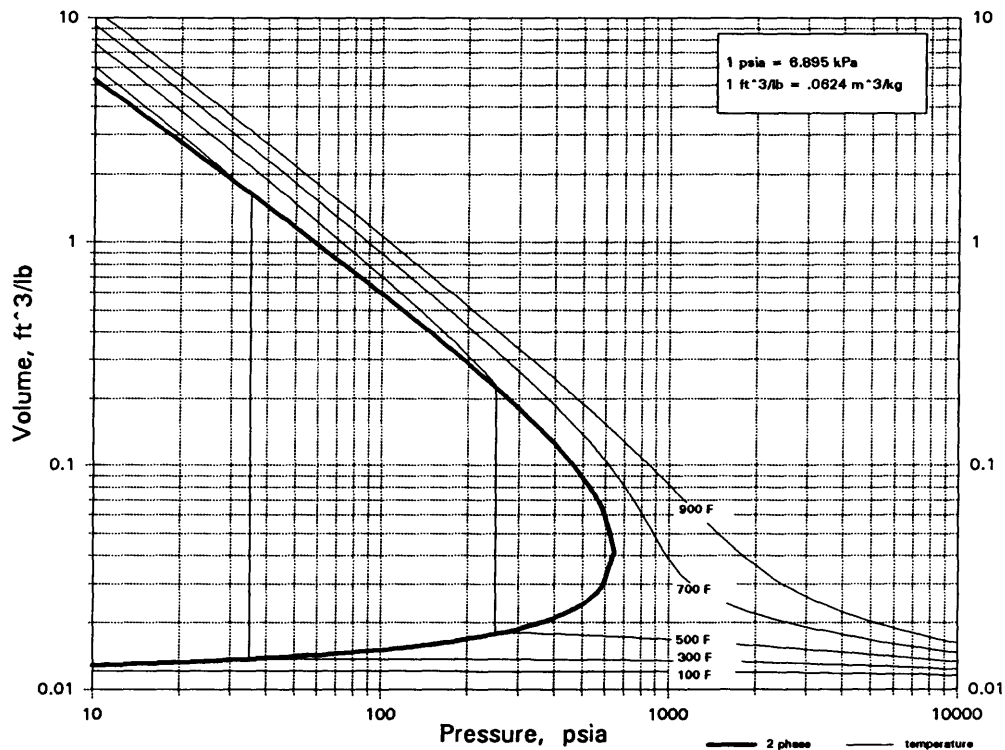
C2H3Cl3

1-1-1-TRICHLOROETHANE



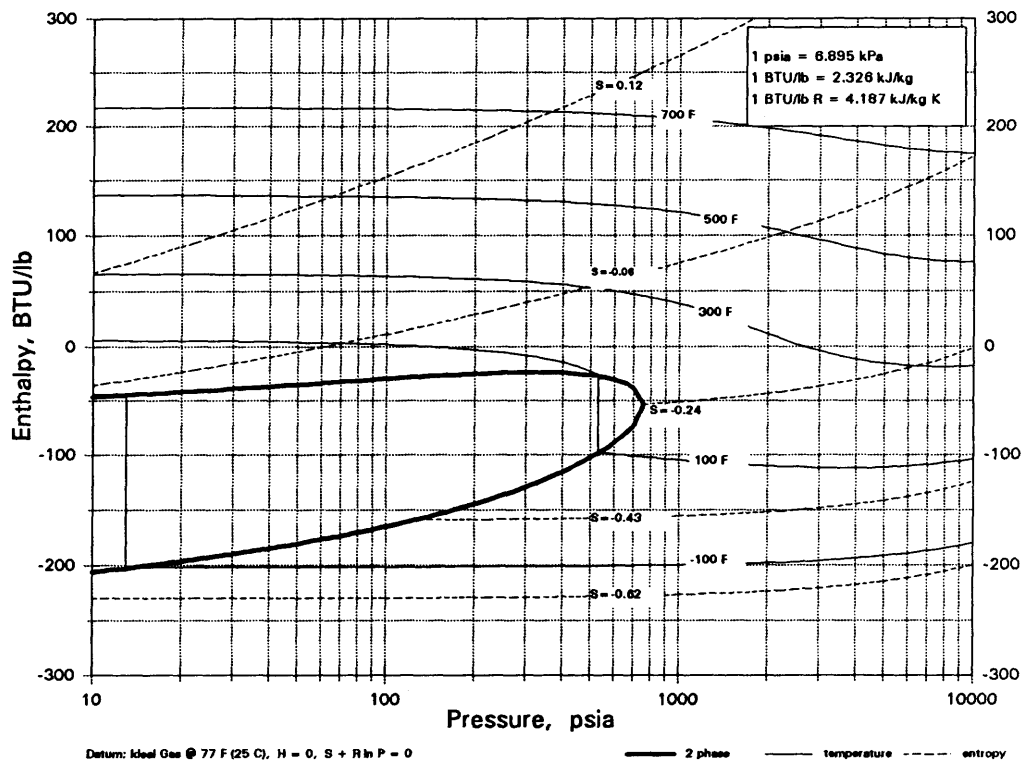
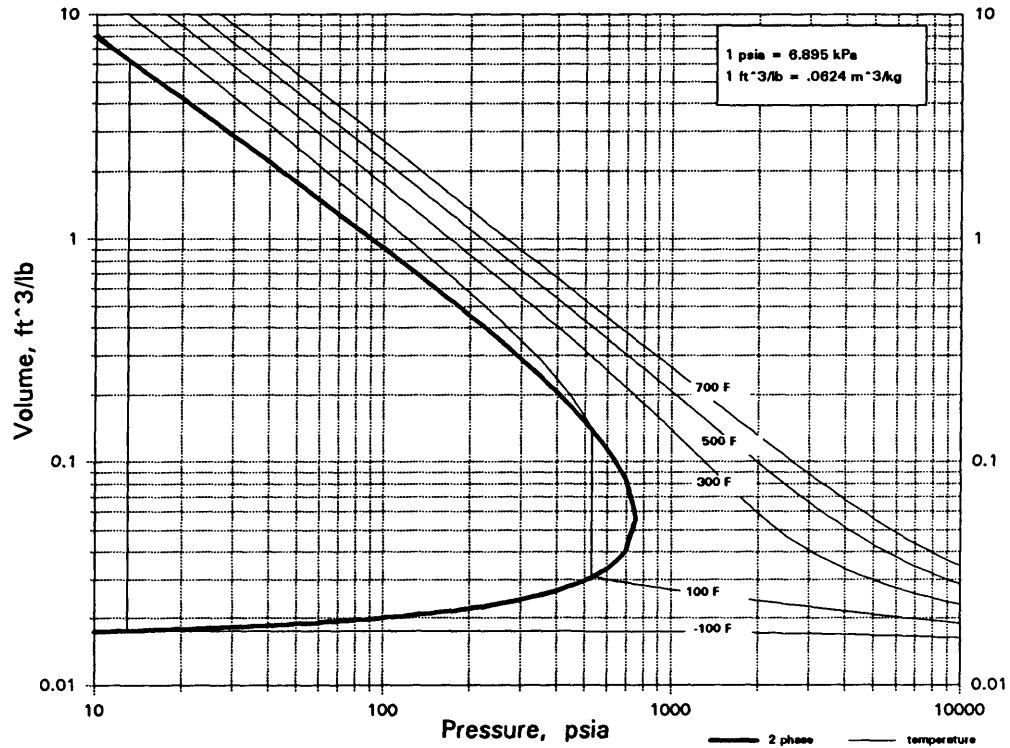
C₂H₃Cl₃

1-1-2-TRICHLOROETHANE



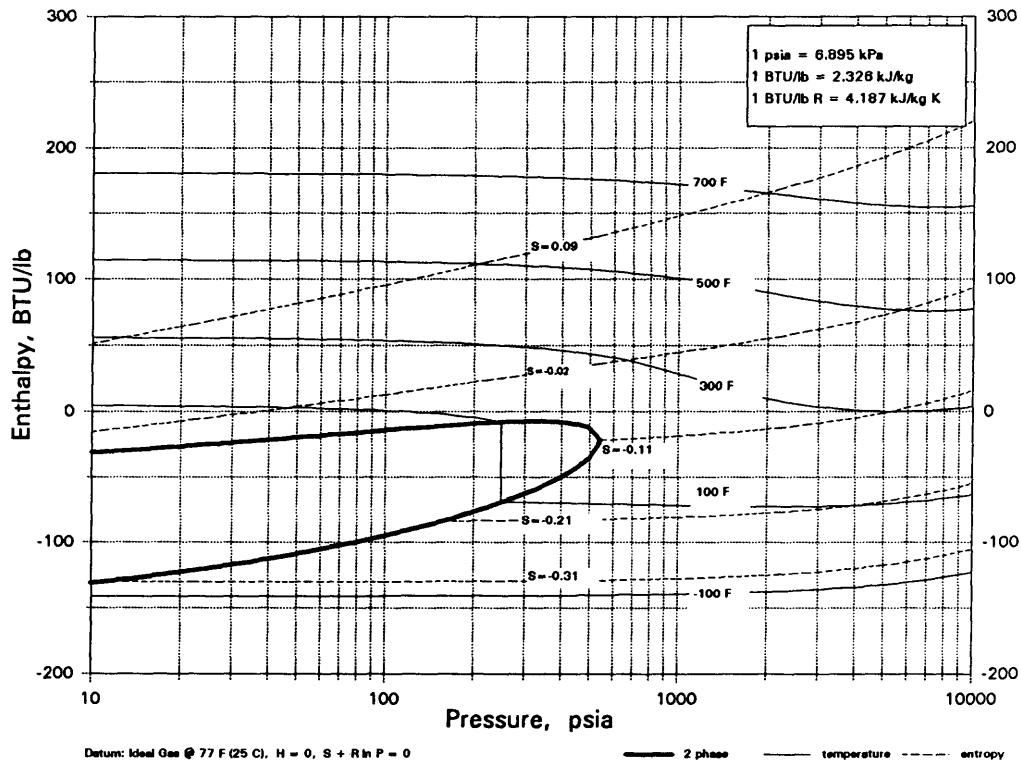
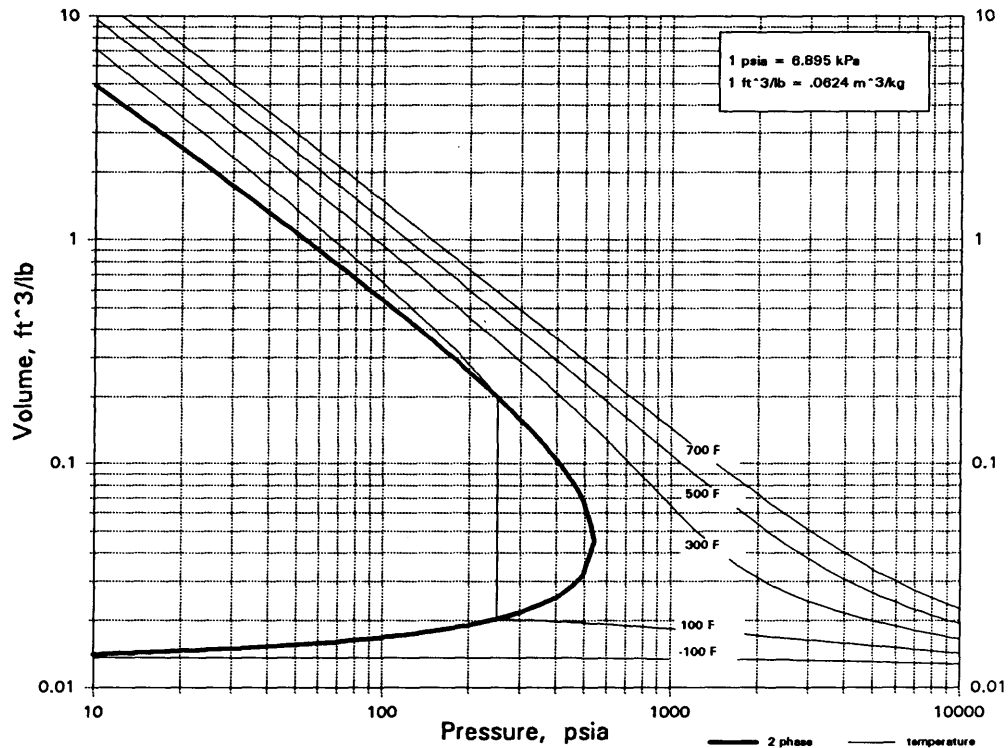
C2H3F

VINYL FLUORIDE



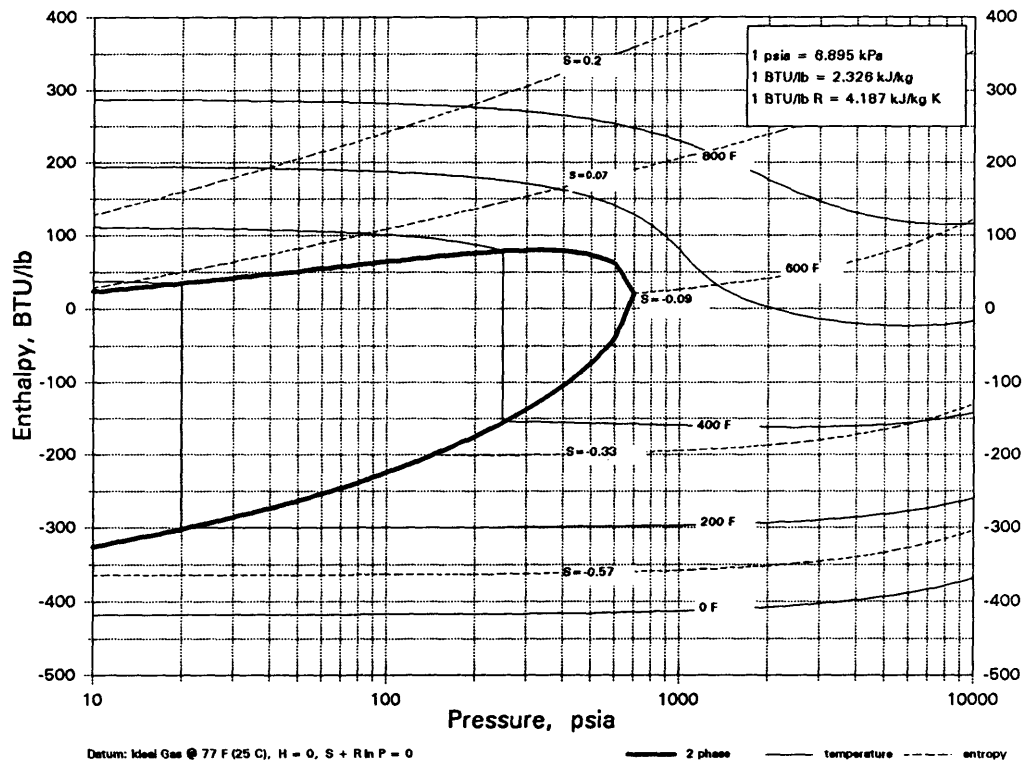
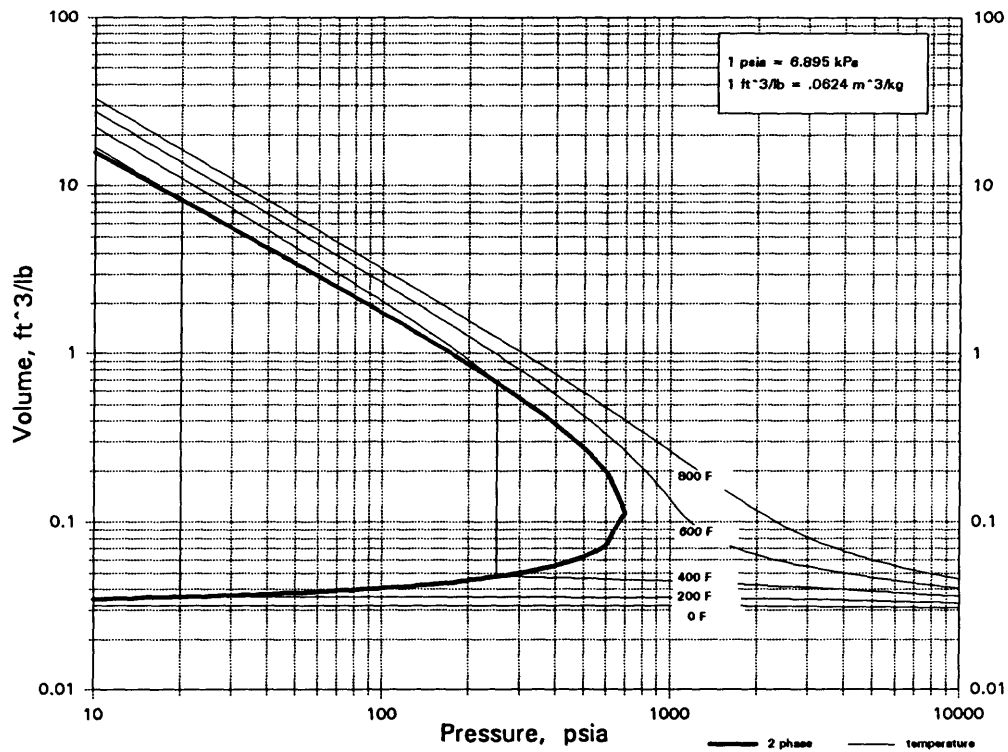
C2H3F3

1-1-1-TRIFLUOROETHANE



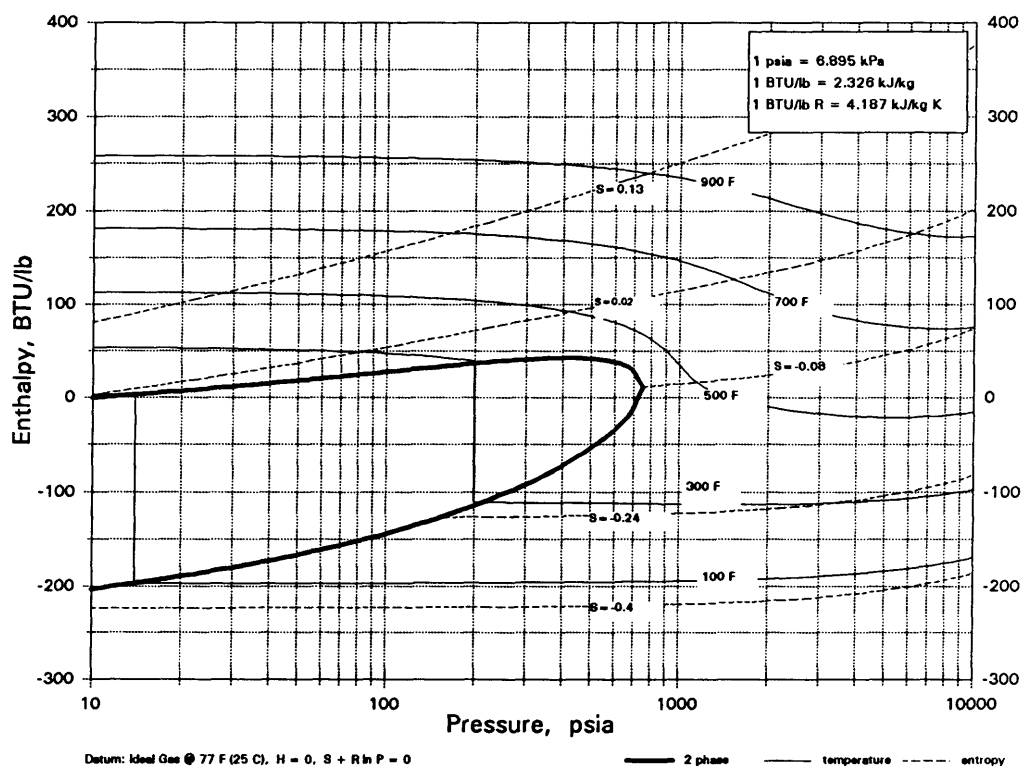
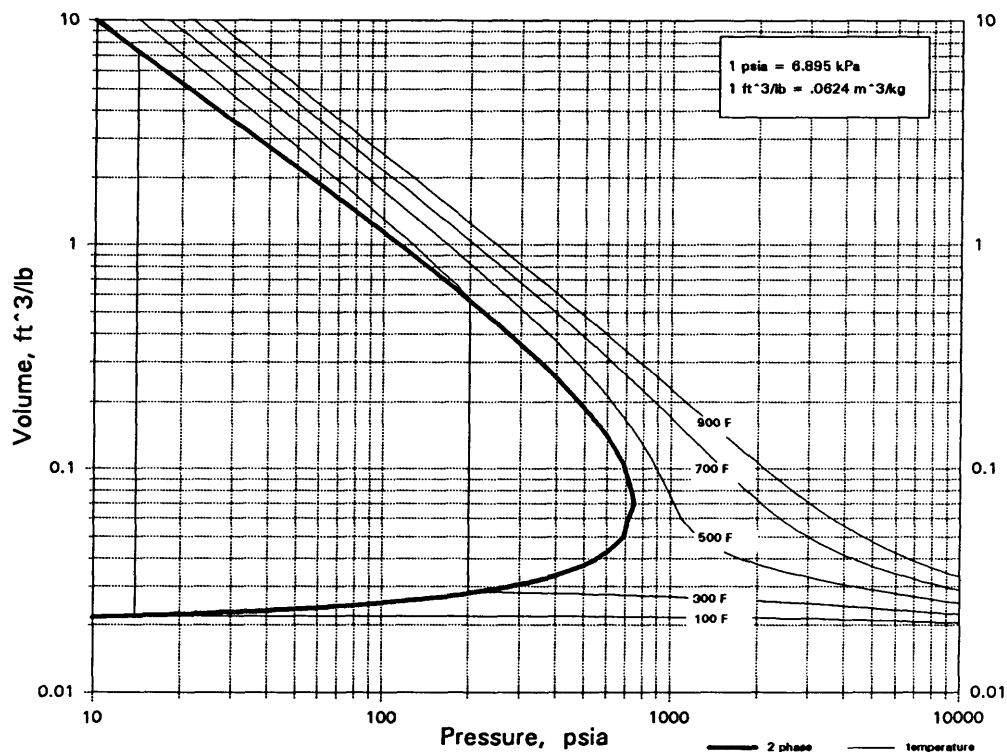
C2H3N

ACETONITRILE

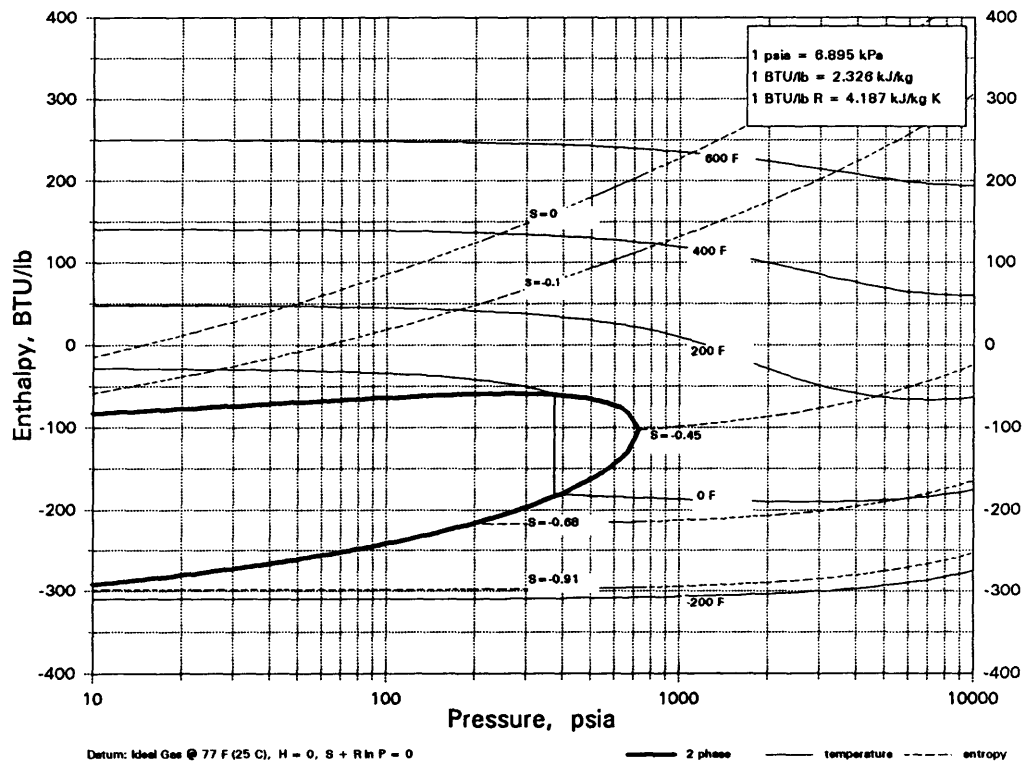
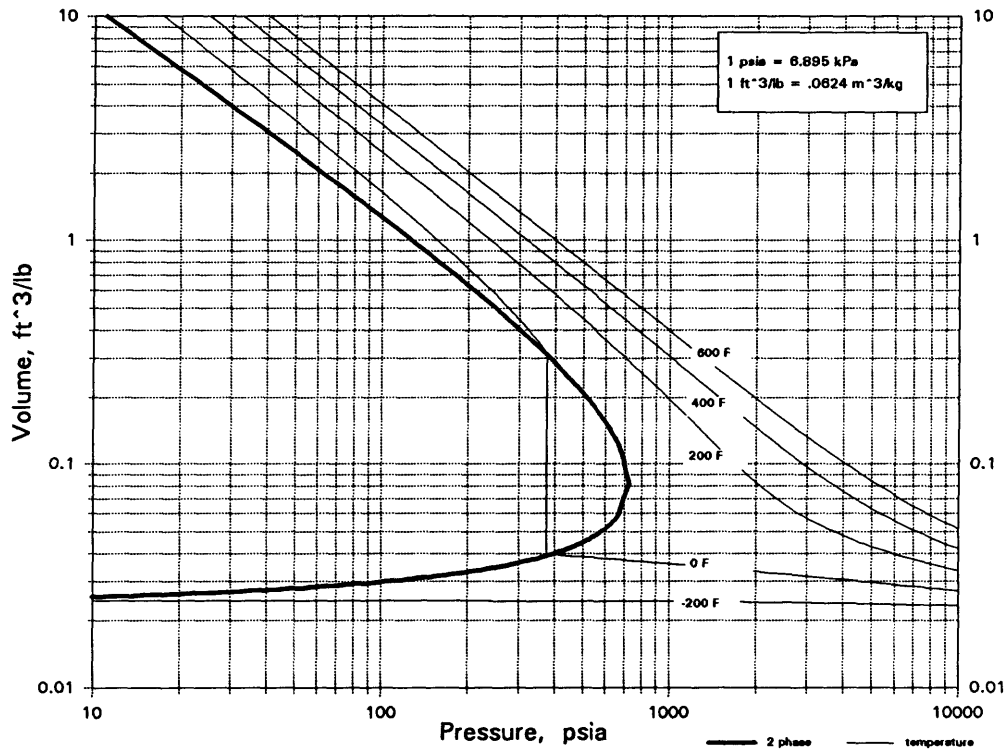


C₂H₃NO

METHYL ISOCYANATE

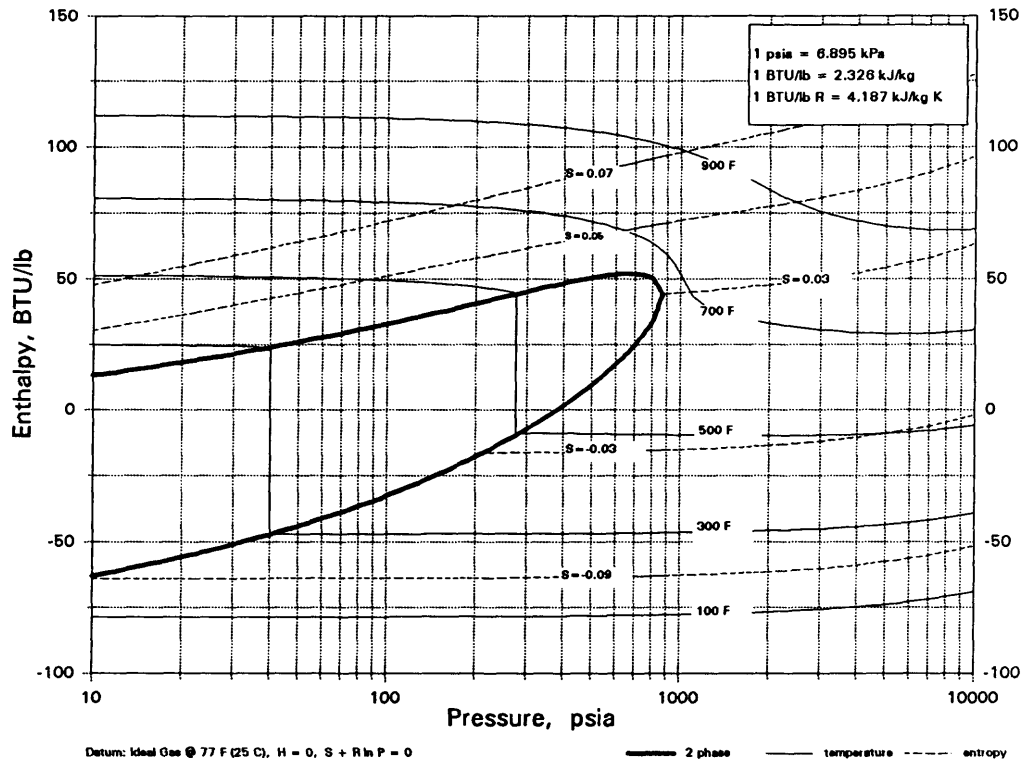
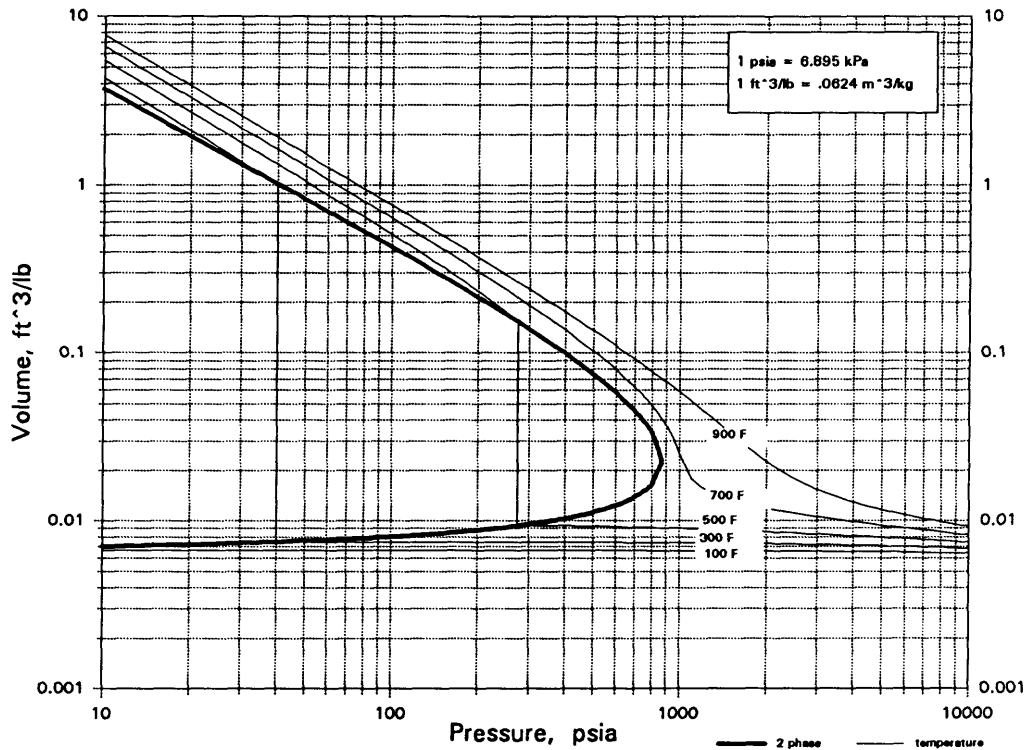


C2H4
ETHYLENE



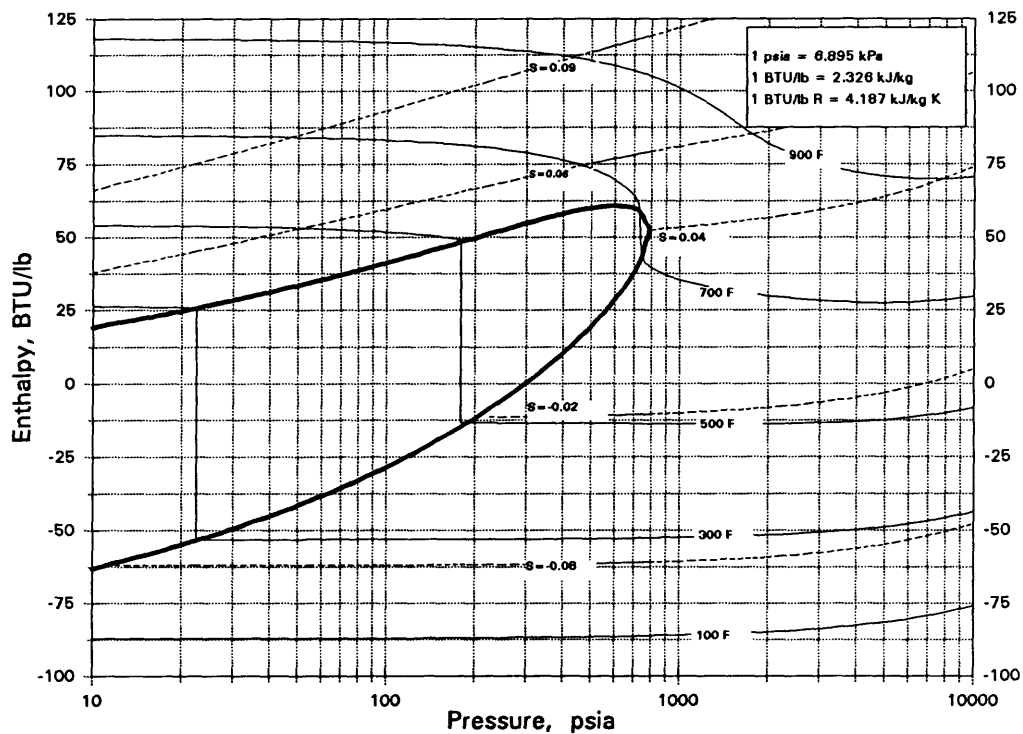
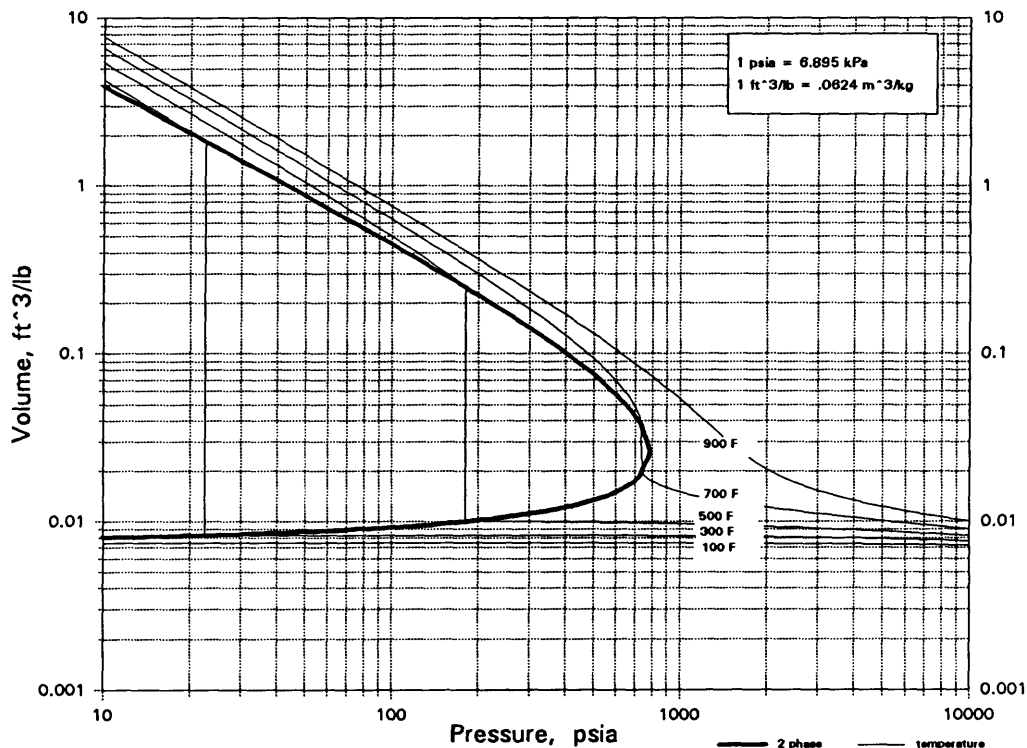
C₂H₄Br₂

1-1-DIBROMOETHANE



C₂H₄Br₂

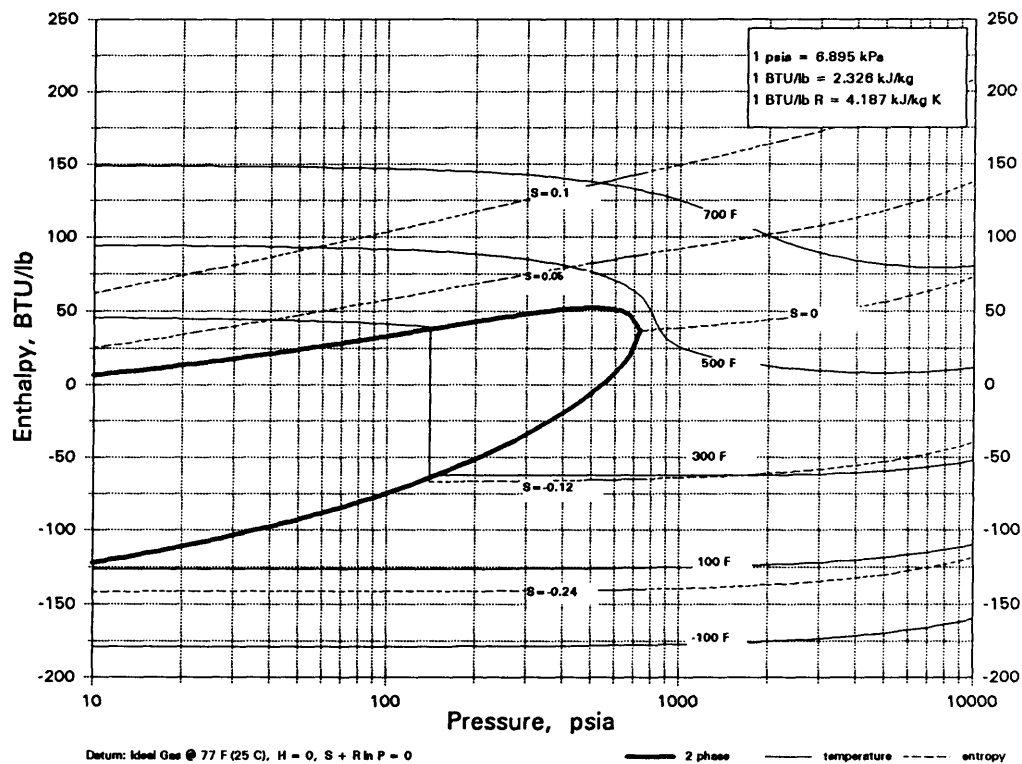
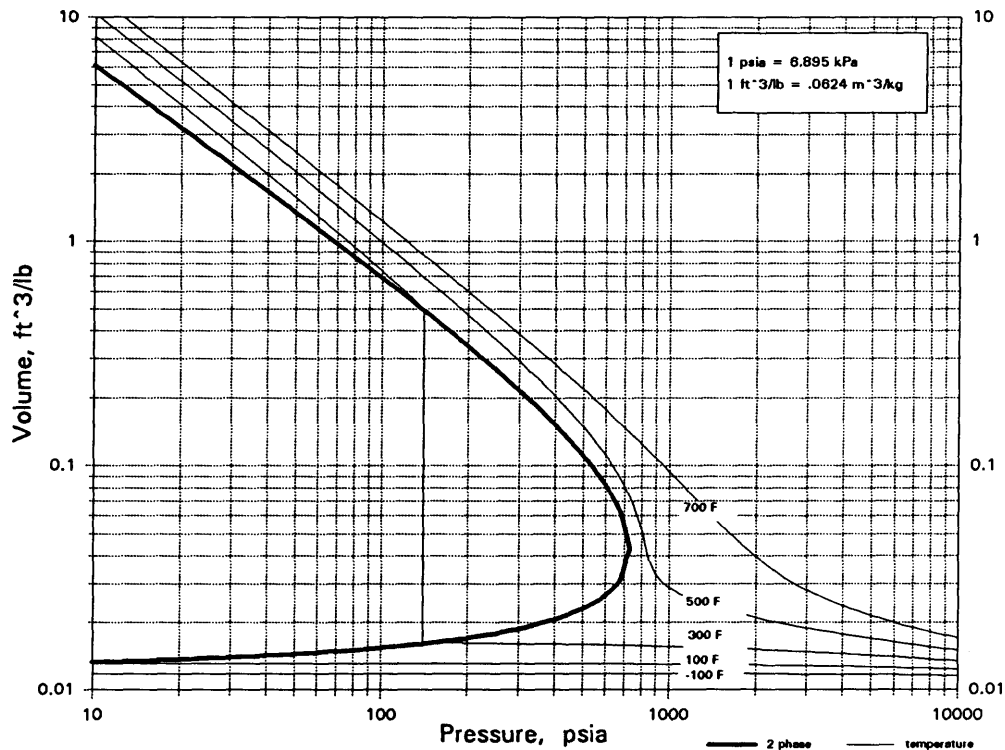
1-2-DIBROMOETHANE



Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

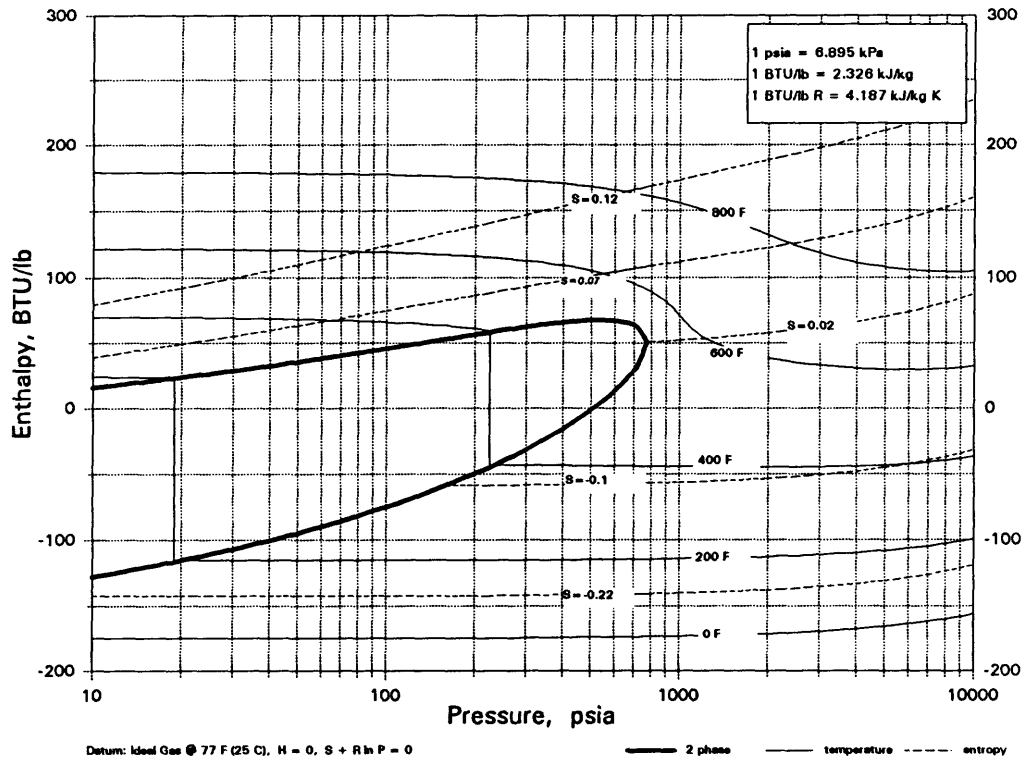
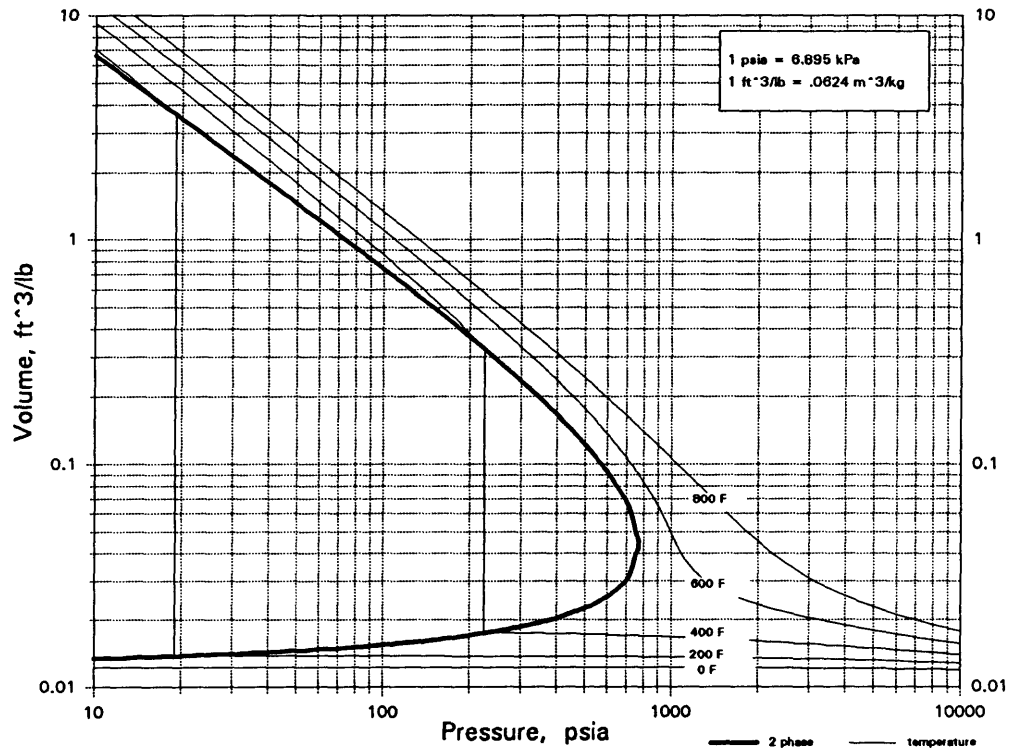
C2H4Cl2

1-1-DICHLOROETHANE



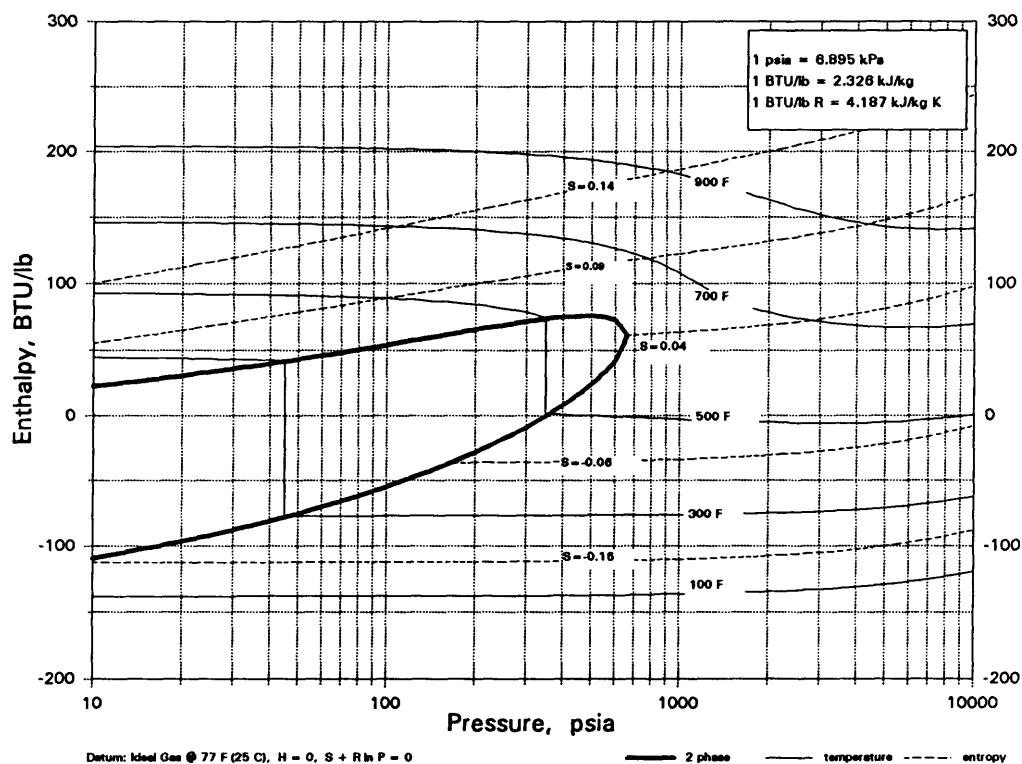
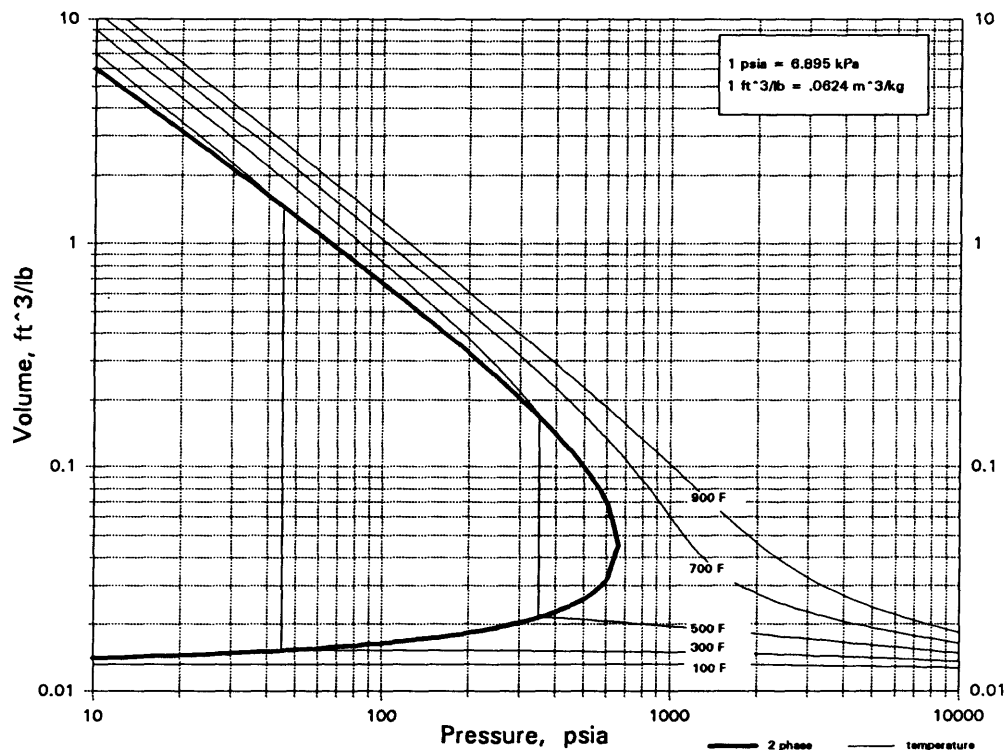
C₂H₄Cl₂

1-2-DICHLOROETHANE



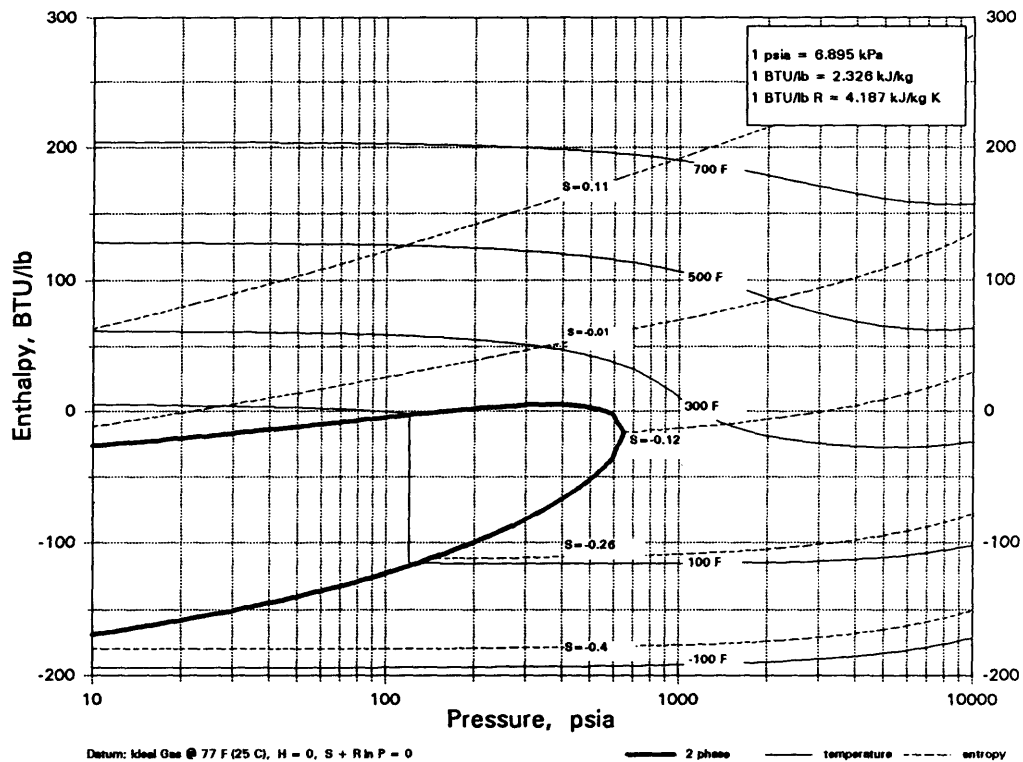
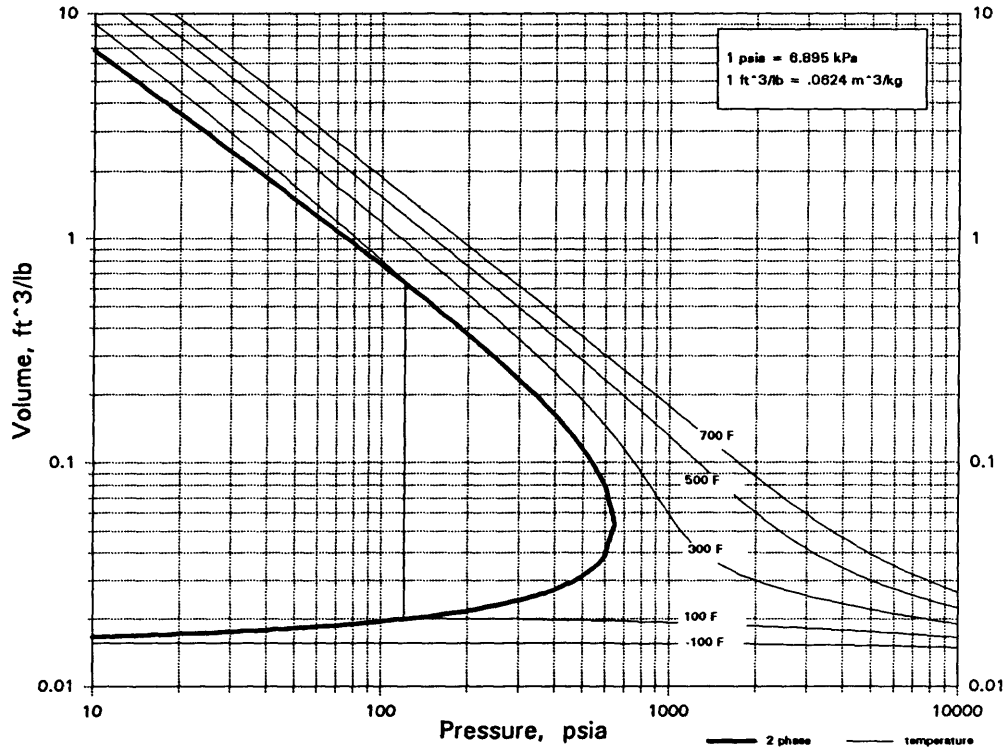
C2H4Cl2O

BIS(CHLOROMETHYL)ETHER



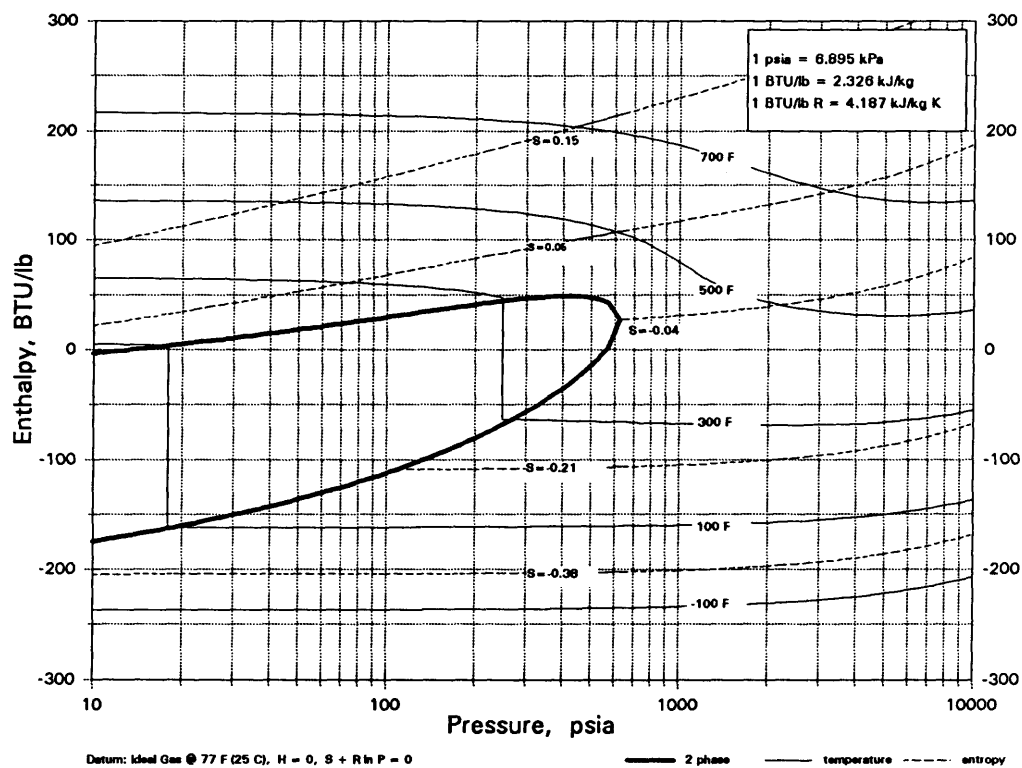
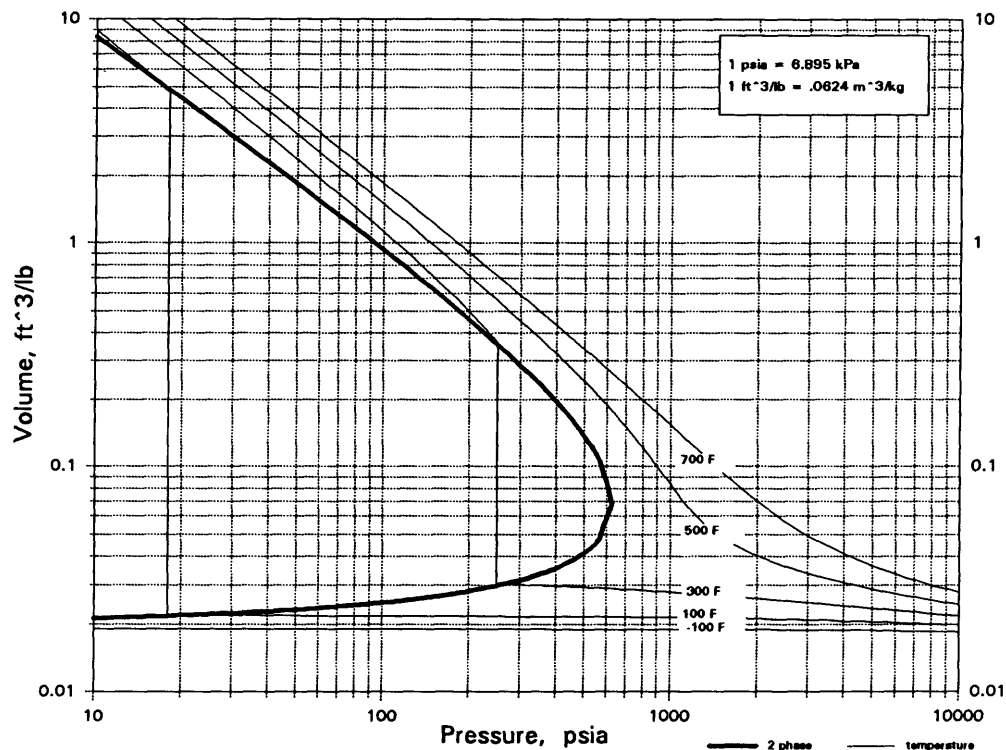
C2H4F2

1-1-DIFLUOROETHANE



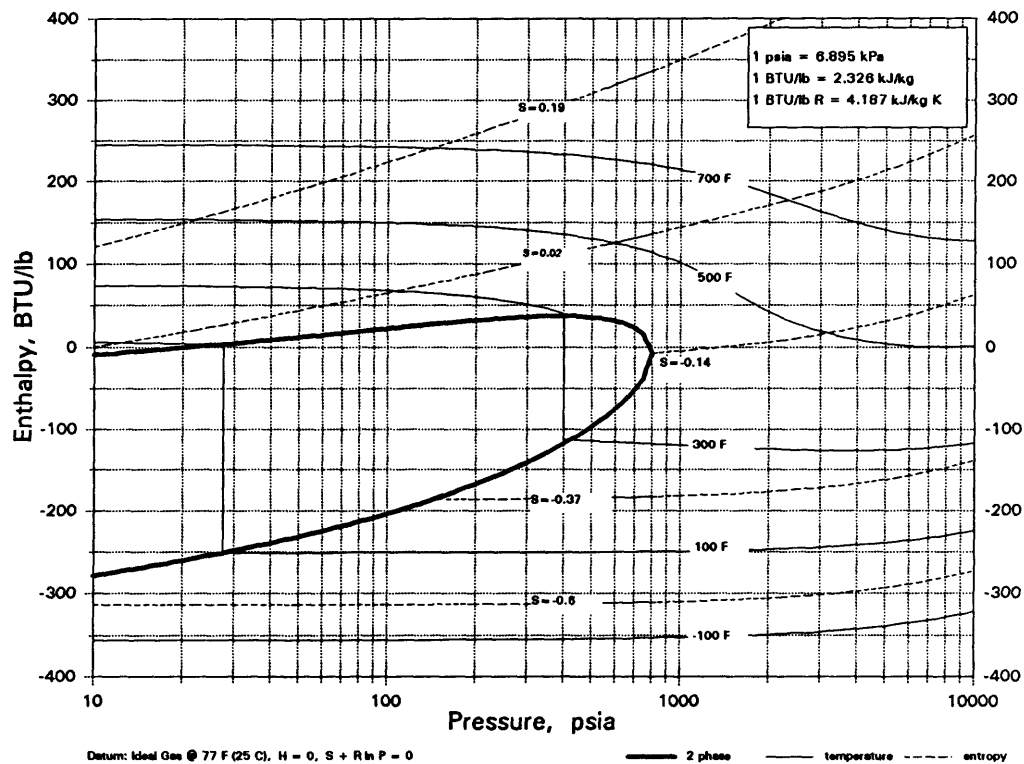
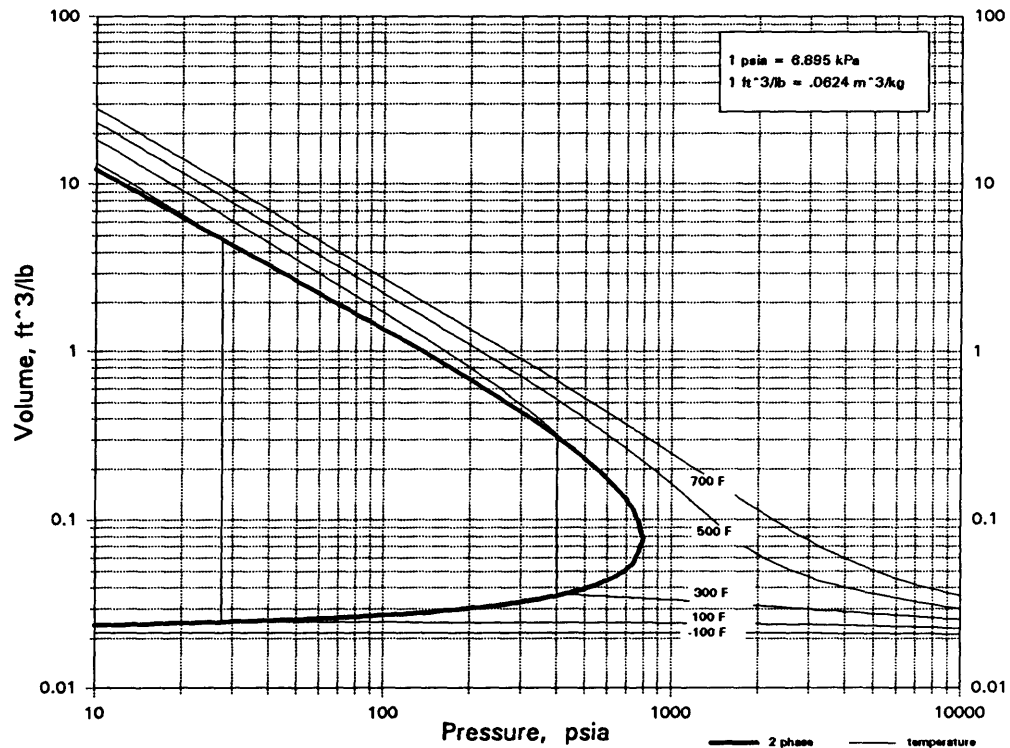
C2H4F2

1-2-DIFLUOROETHANE



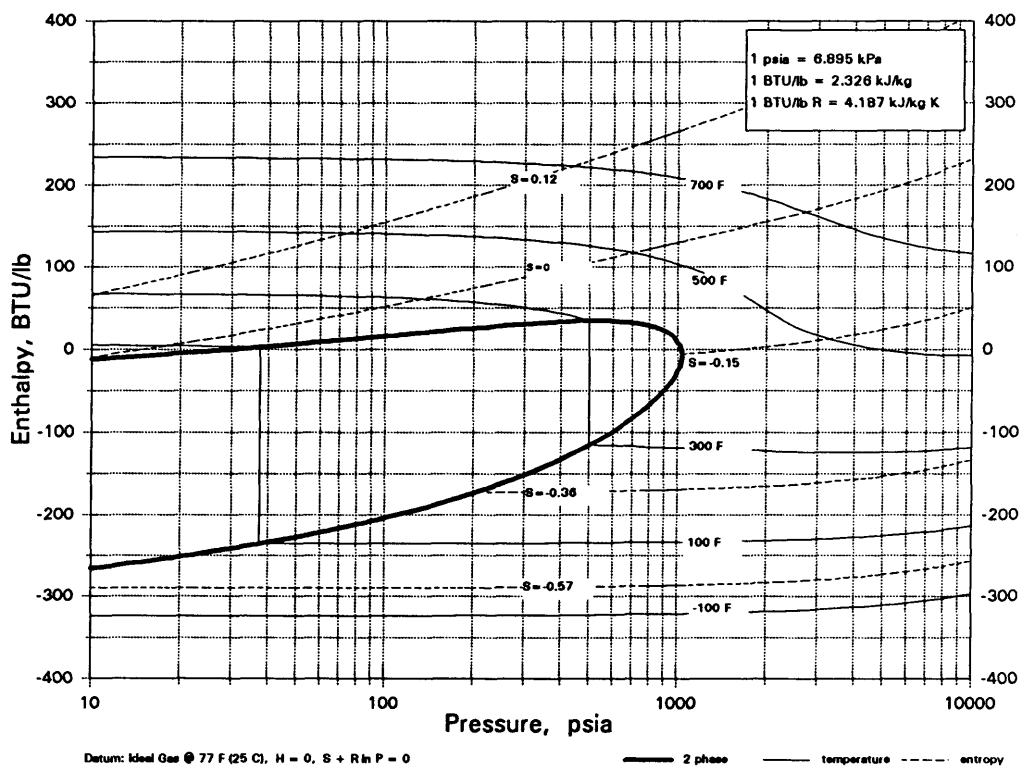
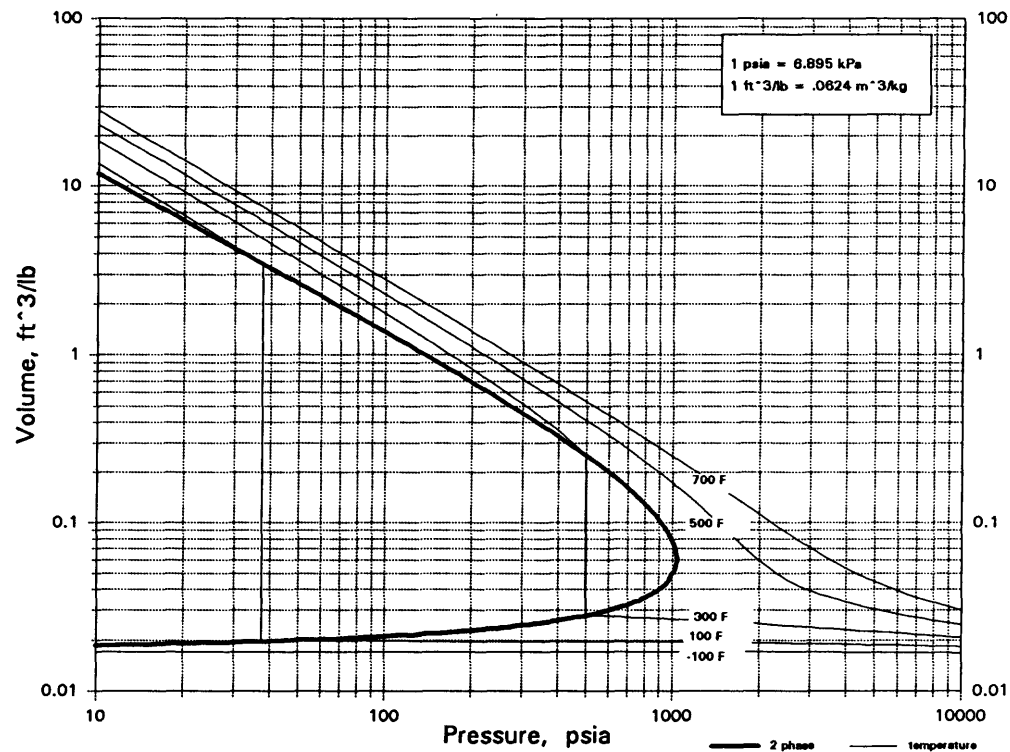
C2H4O

ACETALDEHYDE



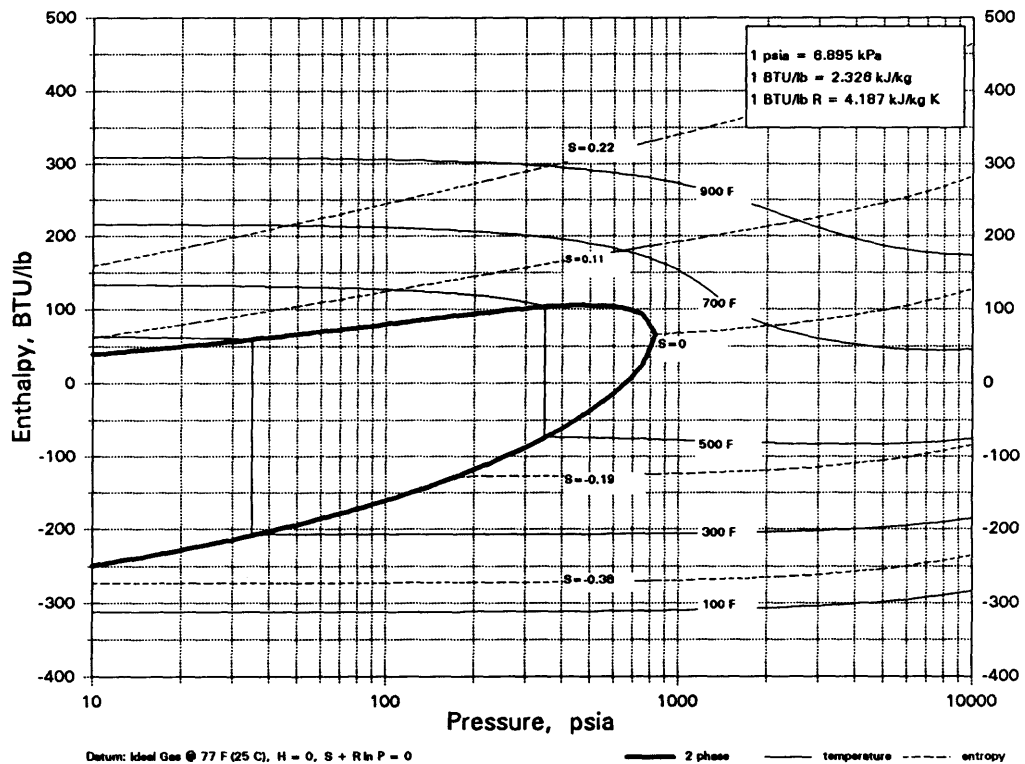
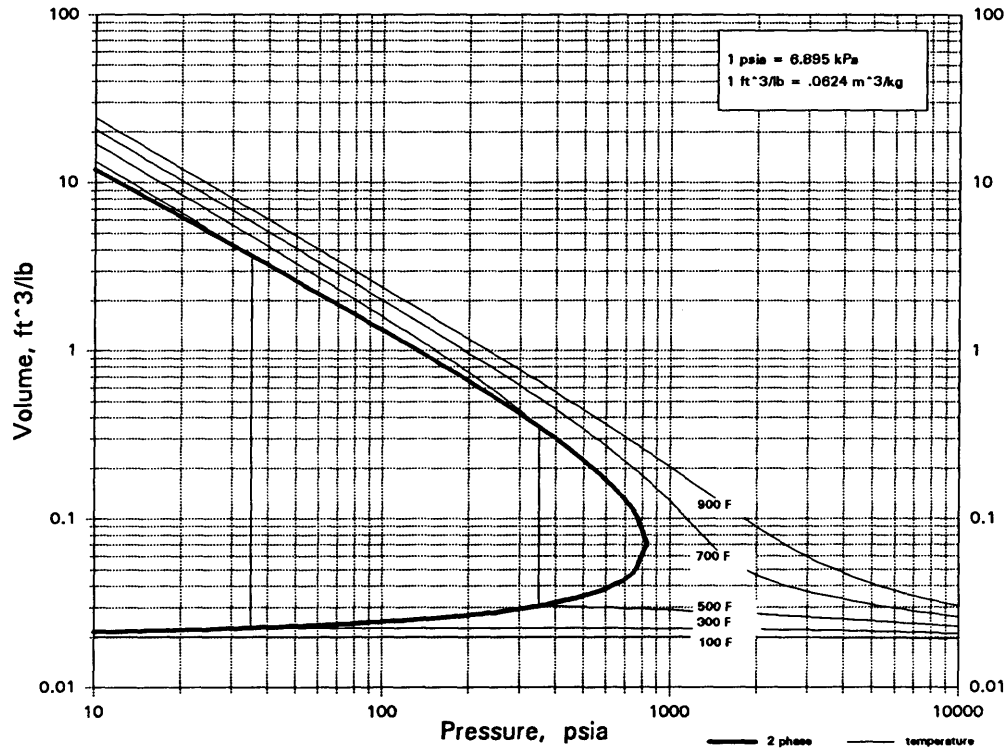
C₂H₄O

ETHYLENE OXIDE



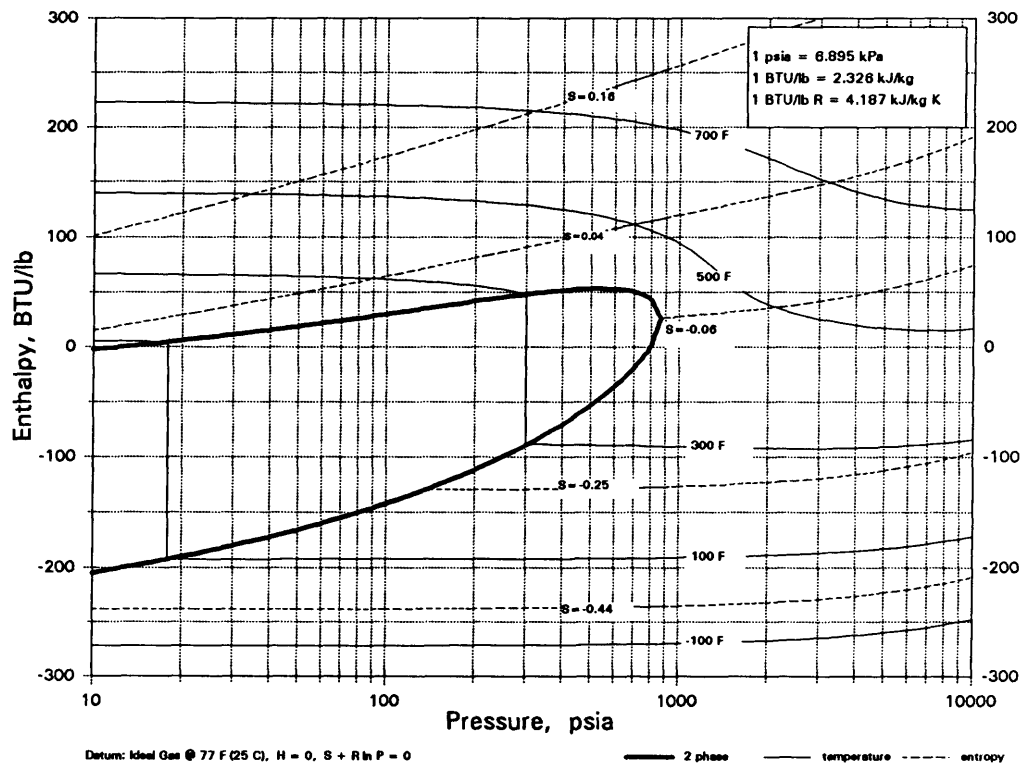
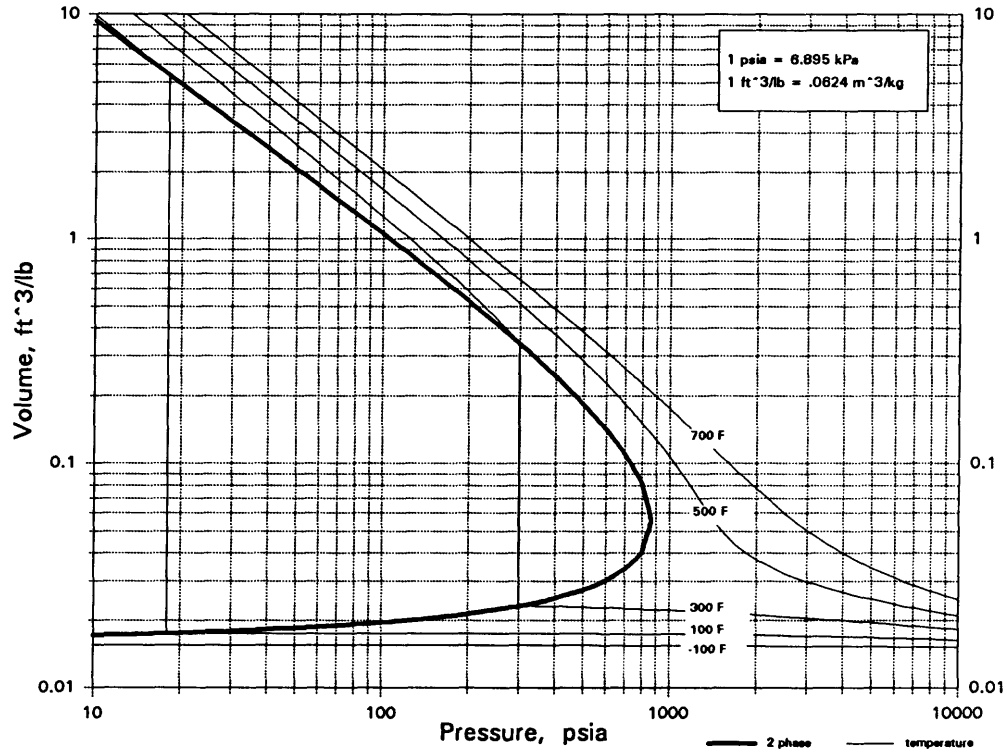
C2H4O2

ACETIC ACID



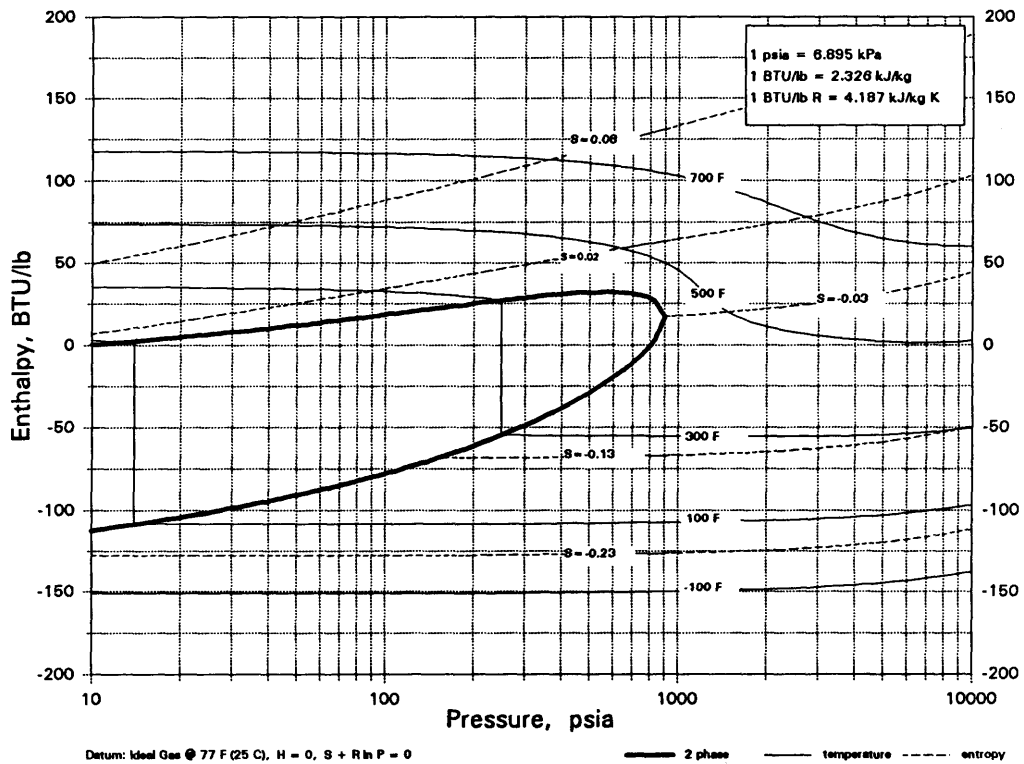
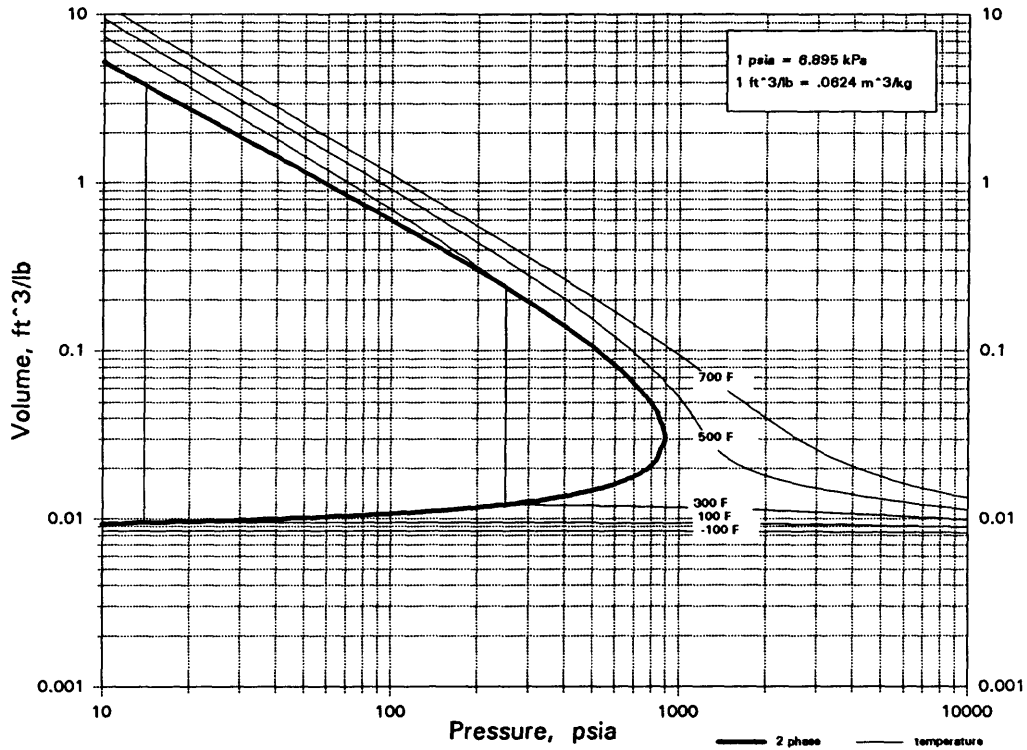
C2H4O2

METHYL FORMATE

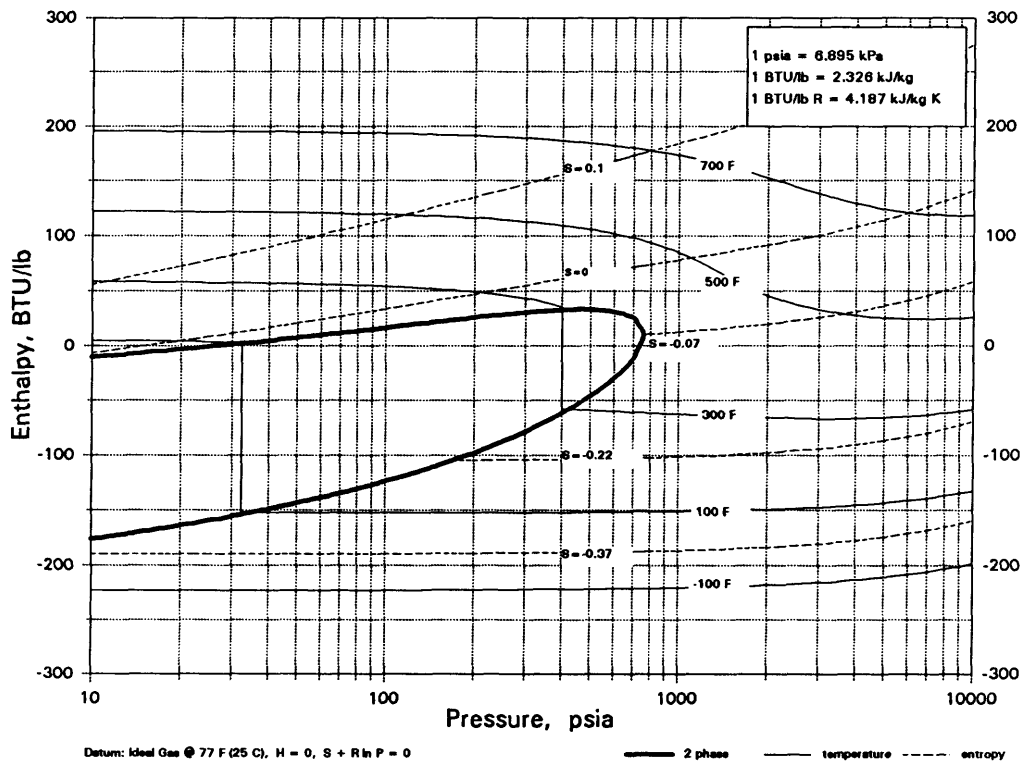
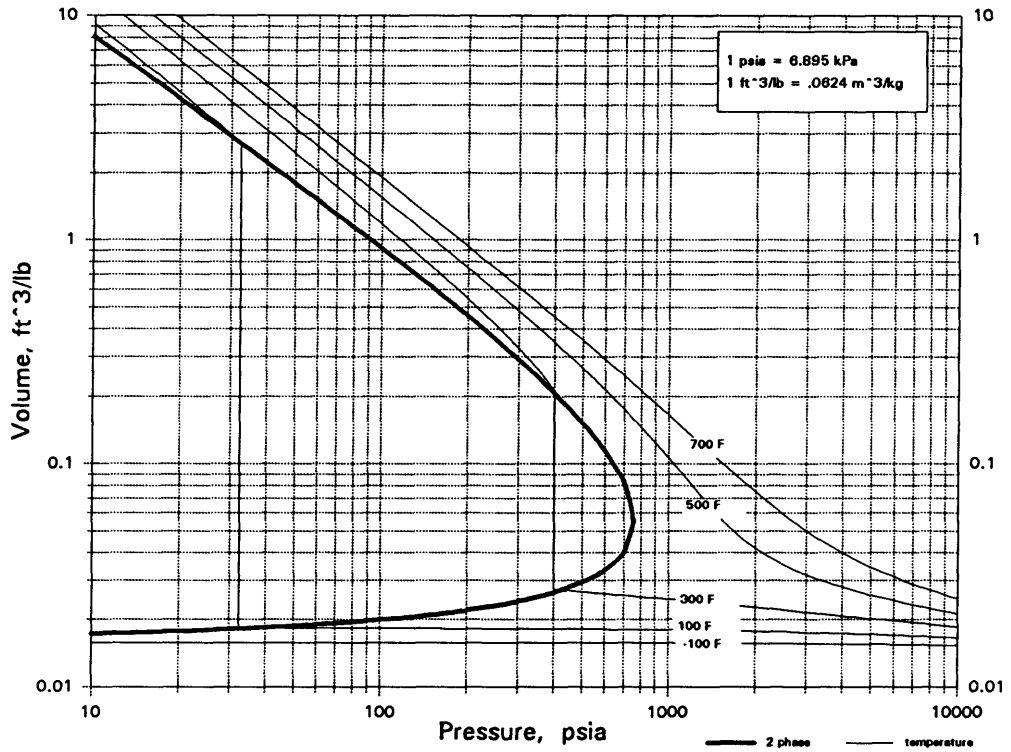


C2H5Br

BROMOETHANE

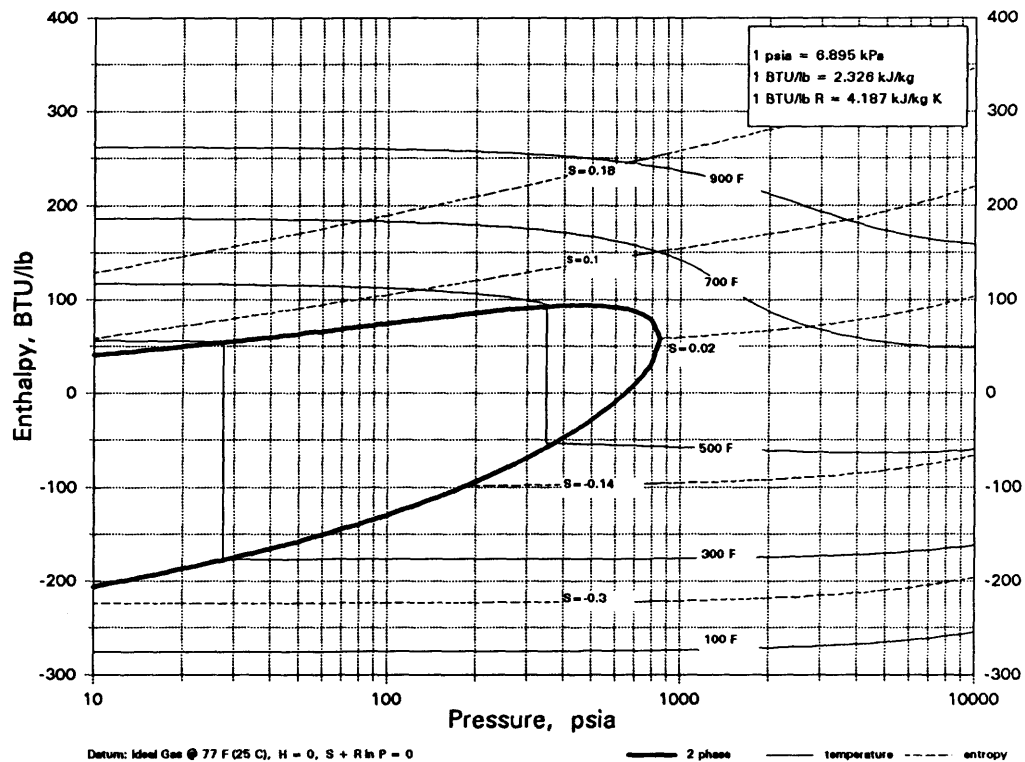
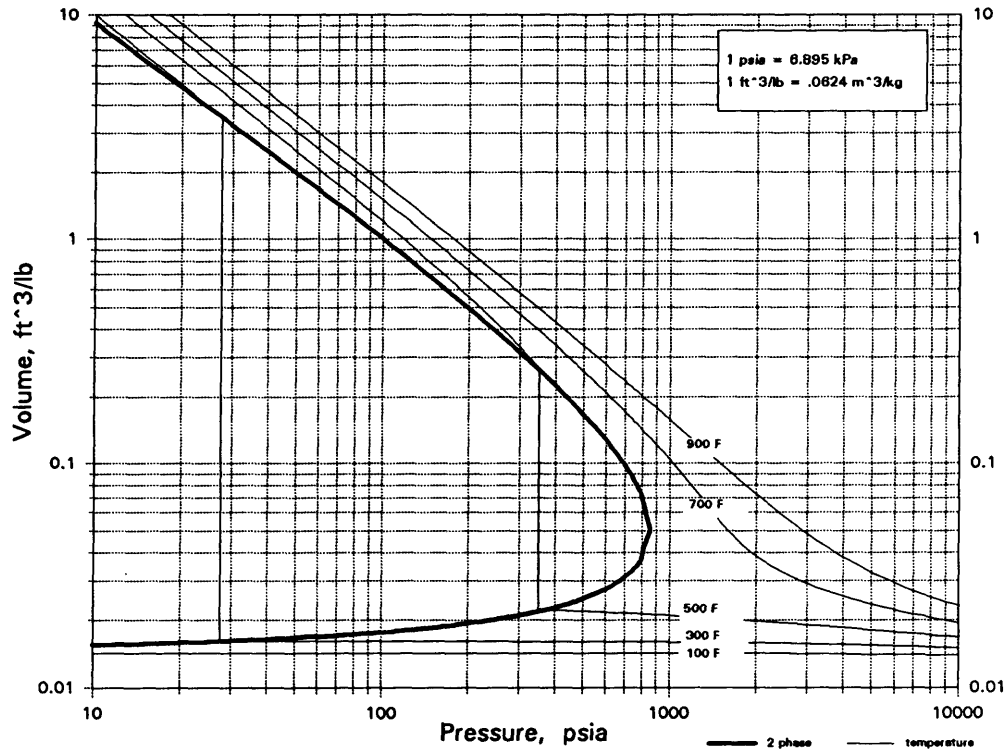


C2H5Cl
ETHYL CHLORIDE

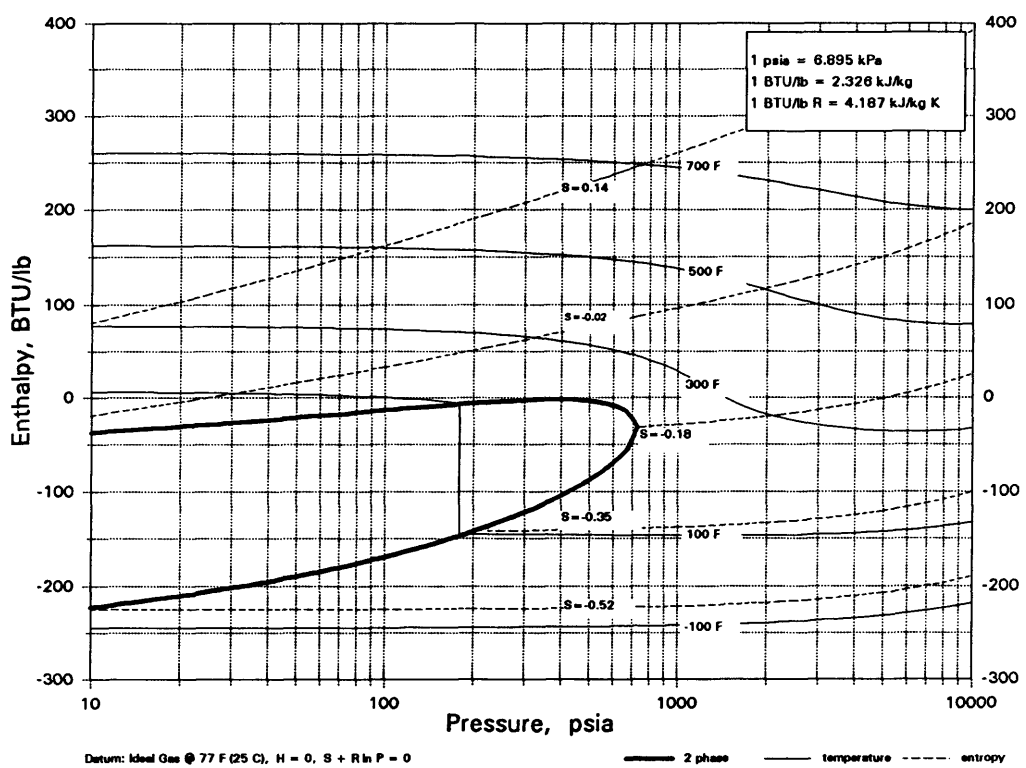
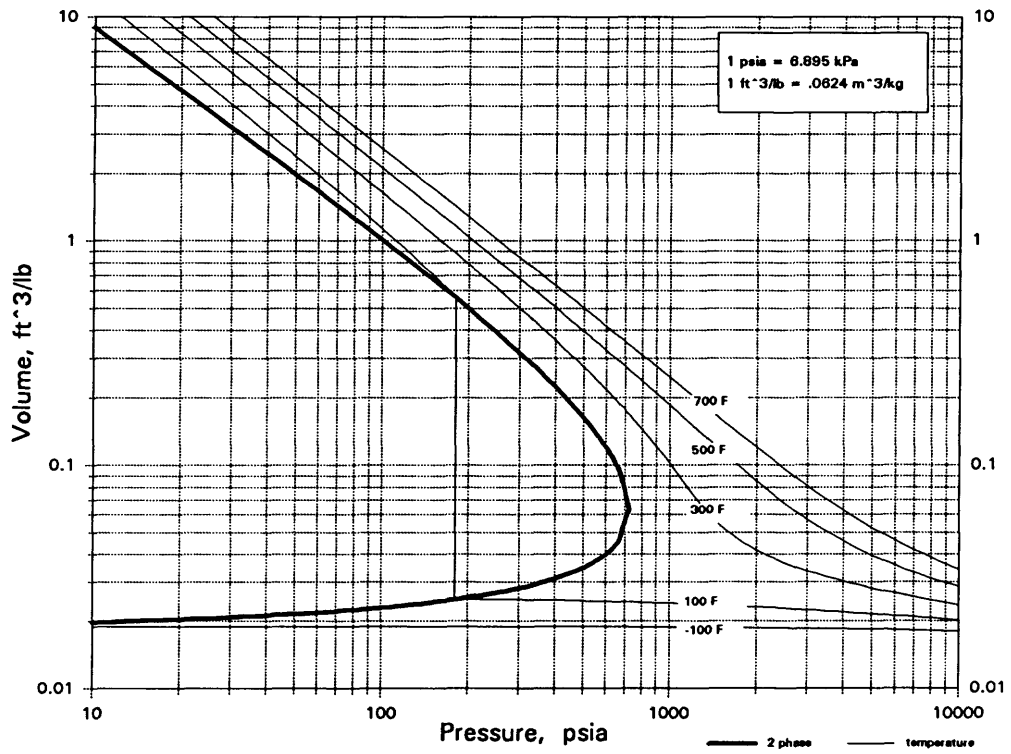


C₂H₅ClO

2-CHLOROETHANOL

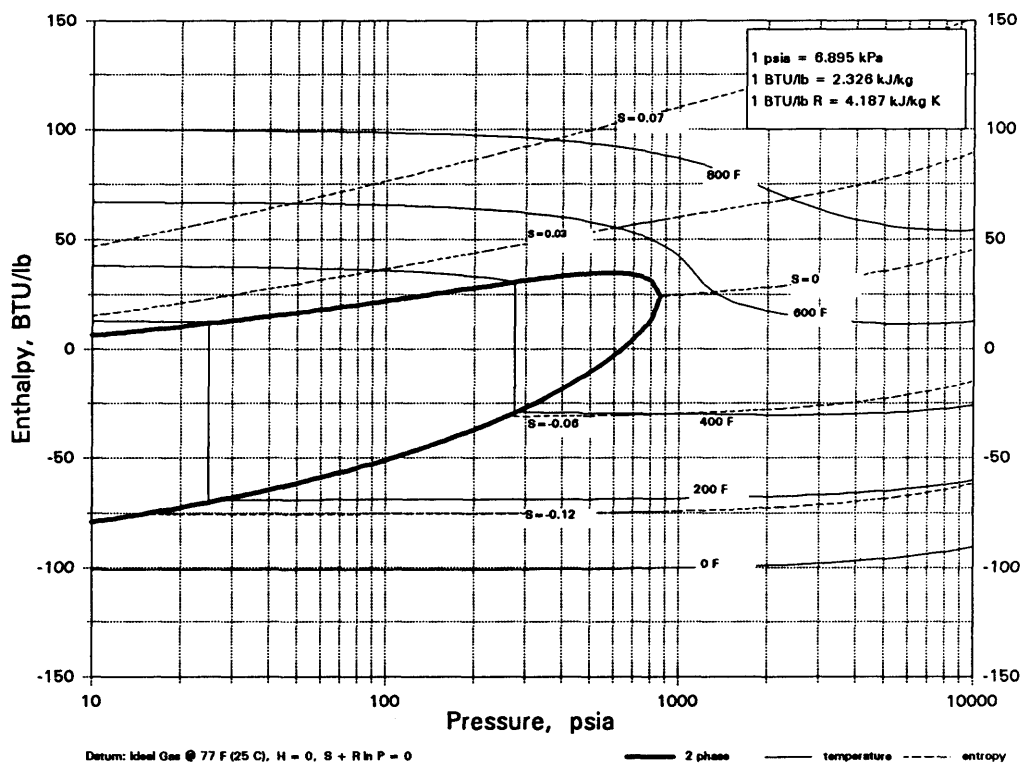
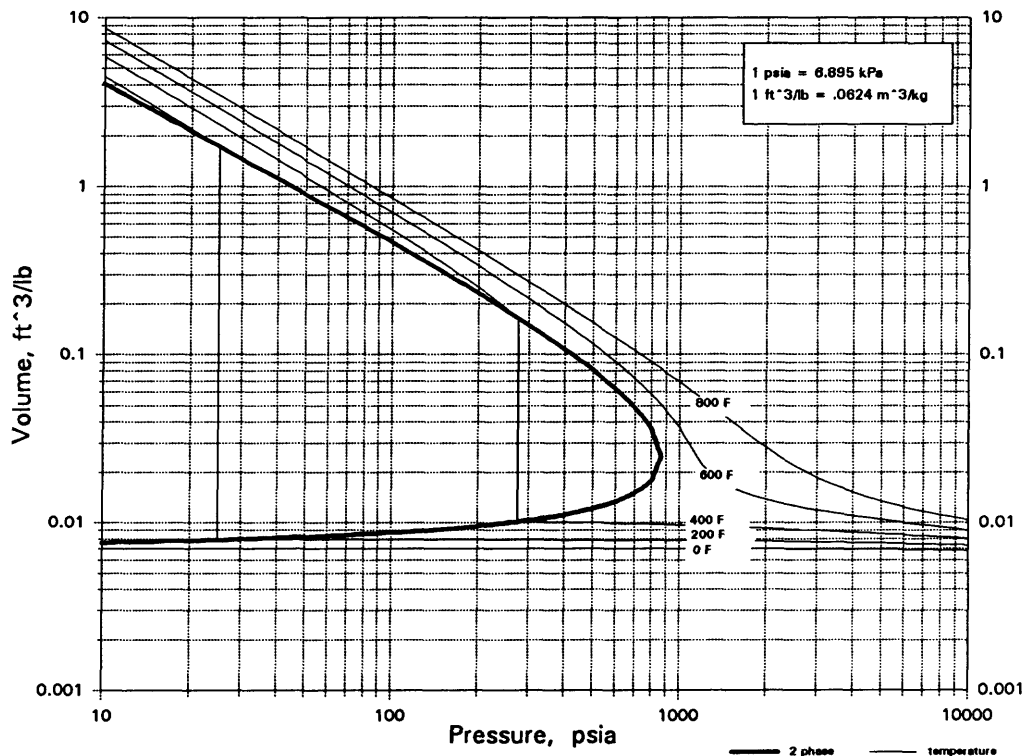


C2H5F
ETHYL FLUORIDE



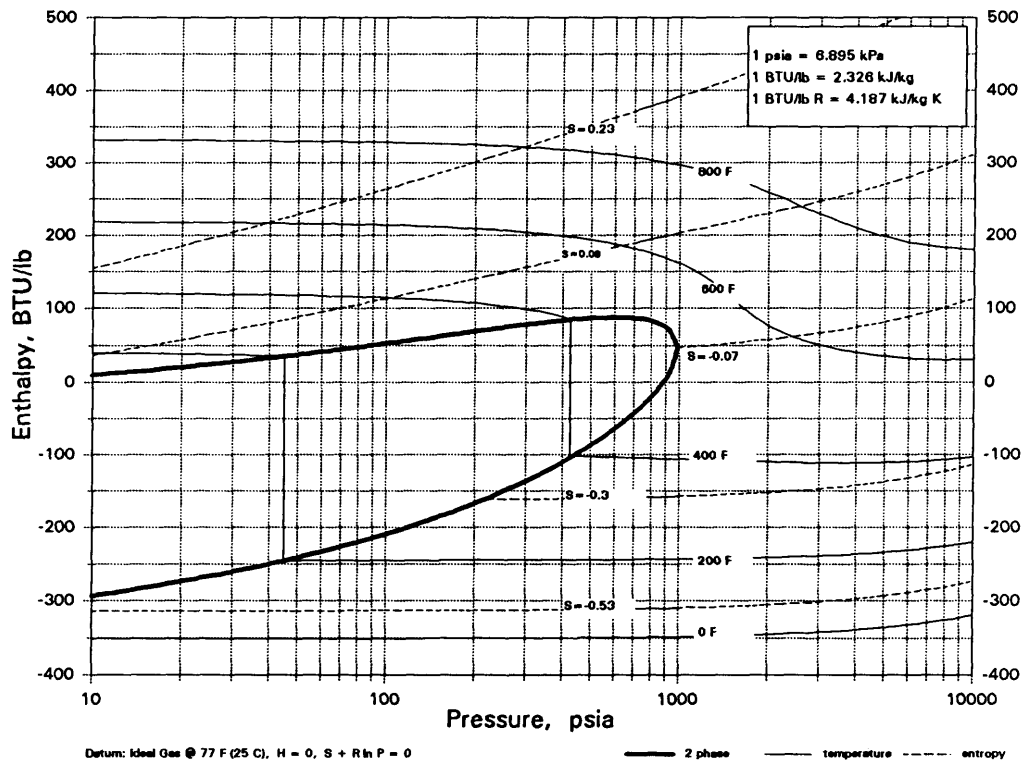
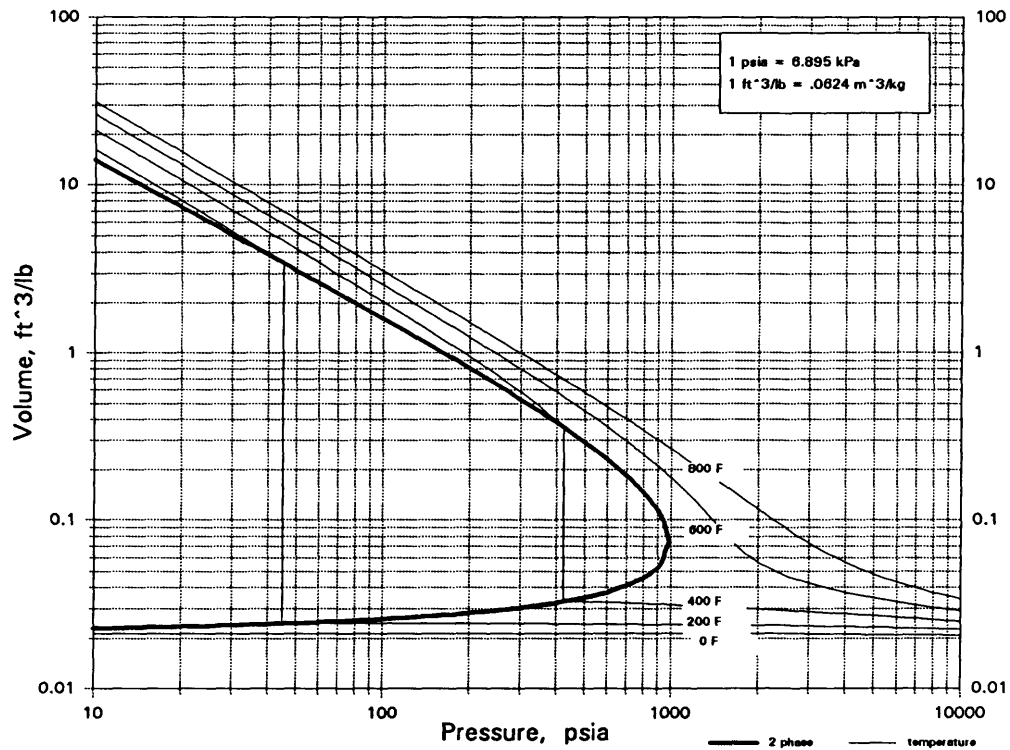
C2H5I

ETHYL IODIDE

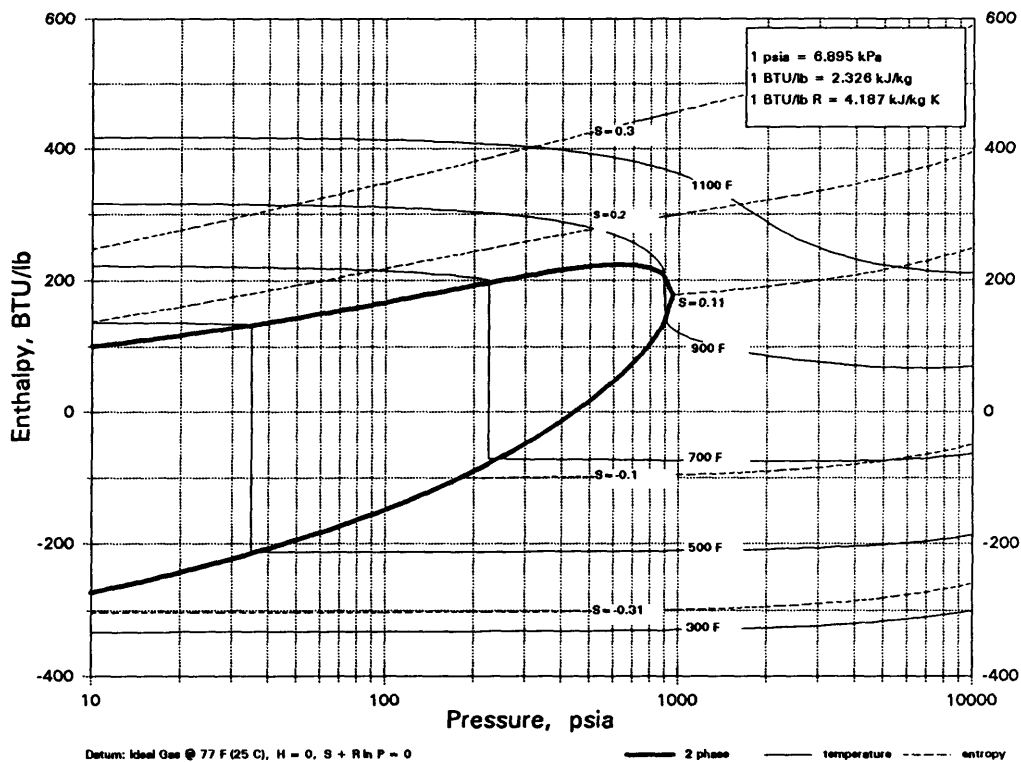
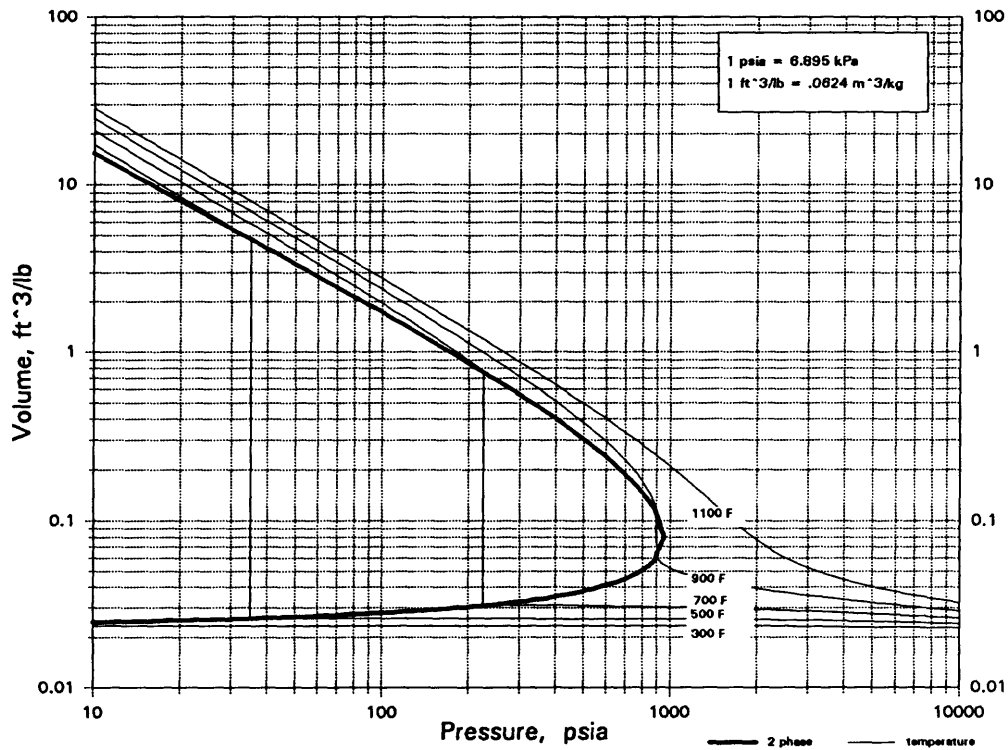


C2H5N

ETHYLENEIMINE

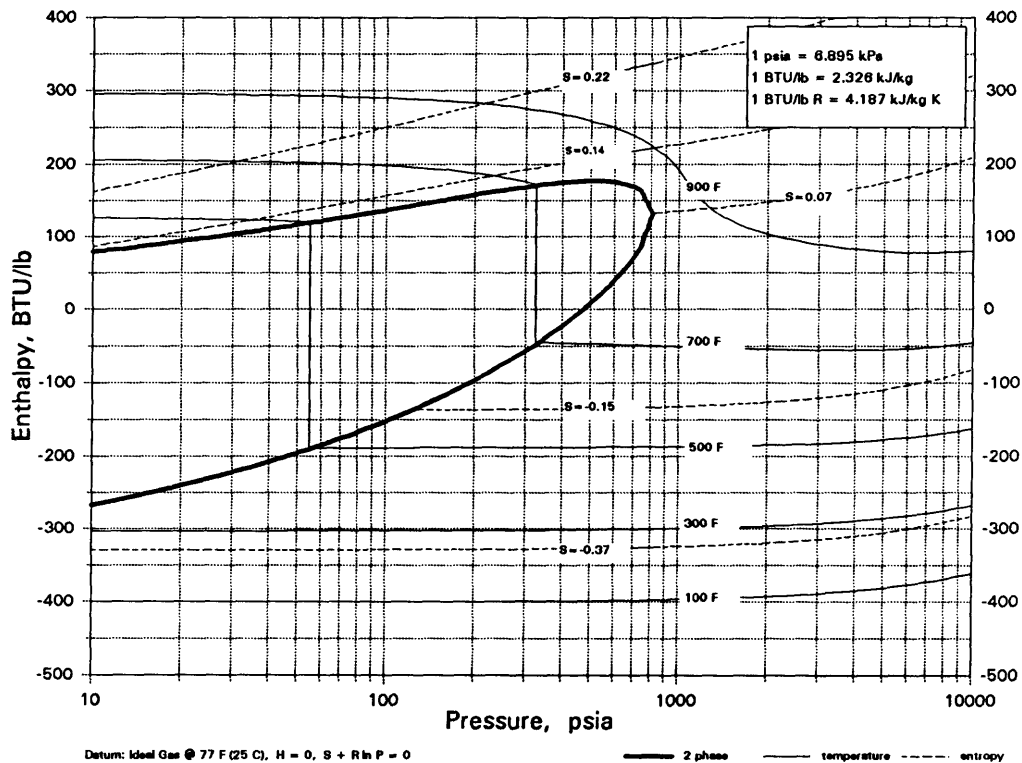
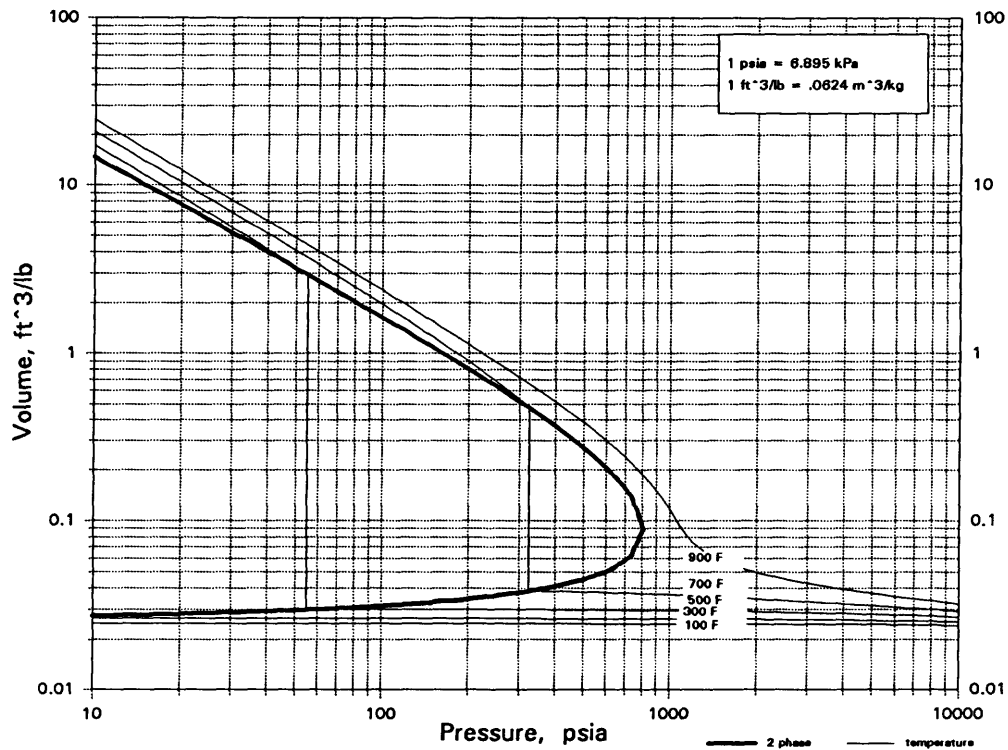


C₂H₅NO
ACETAMIDE

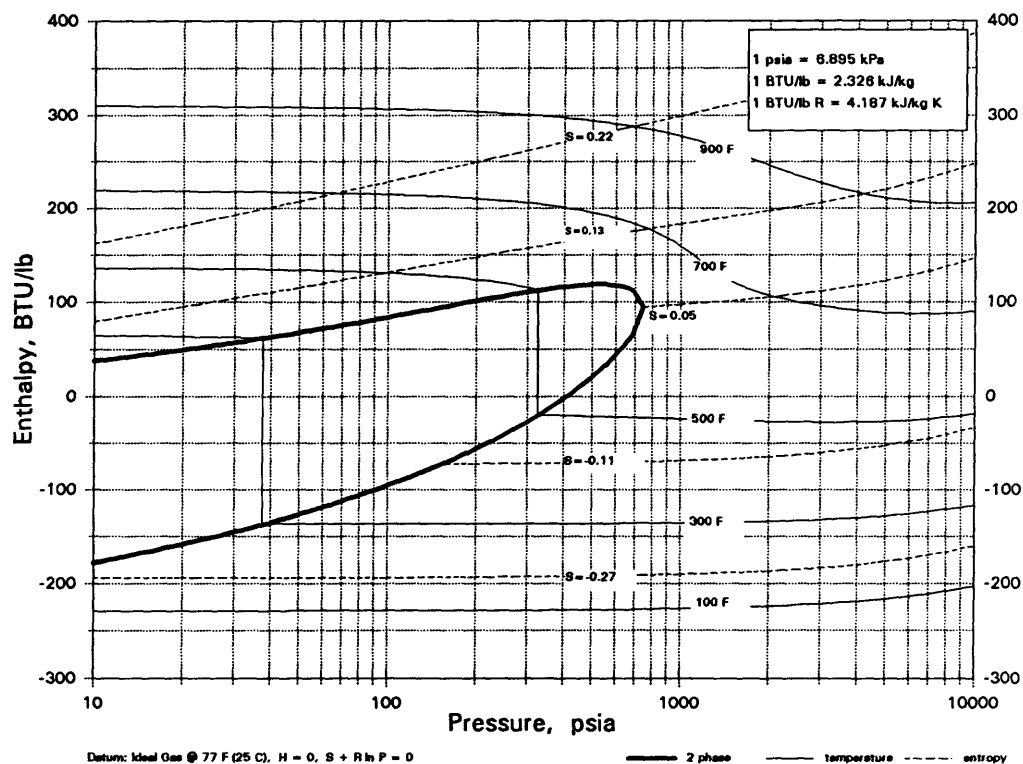
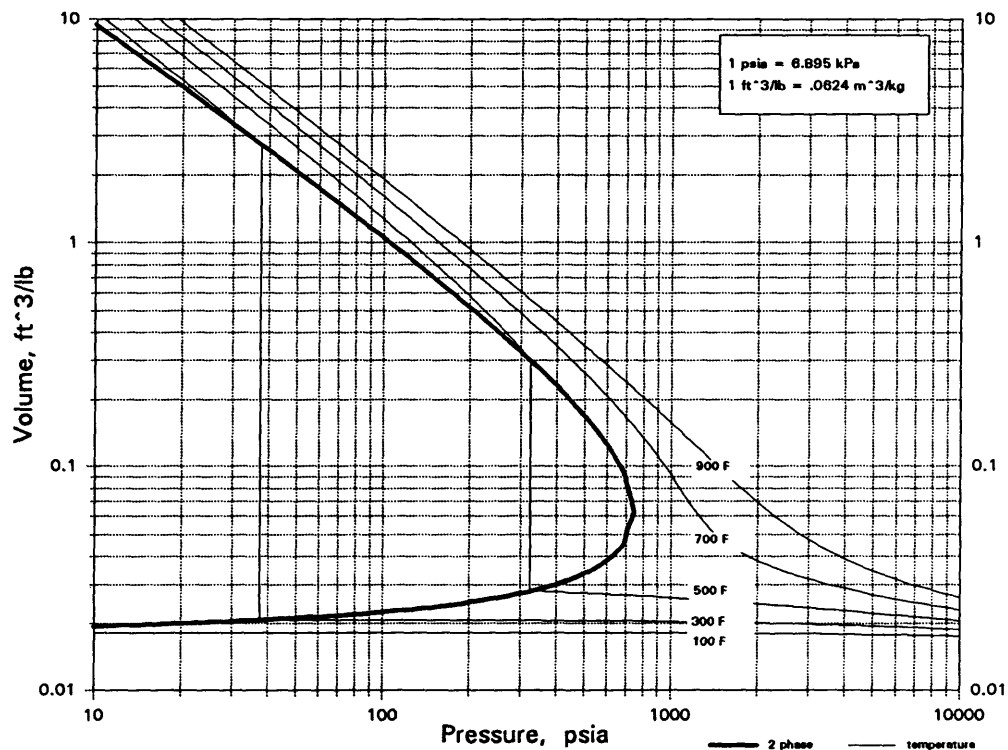


C₂H₅NO

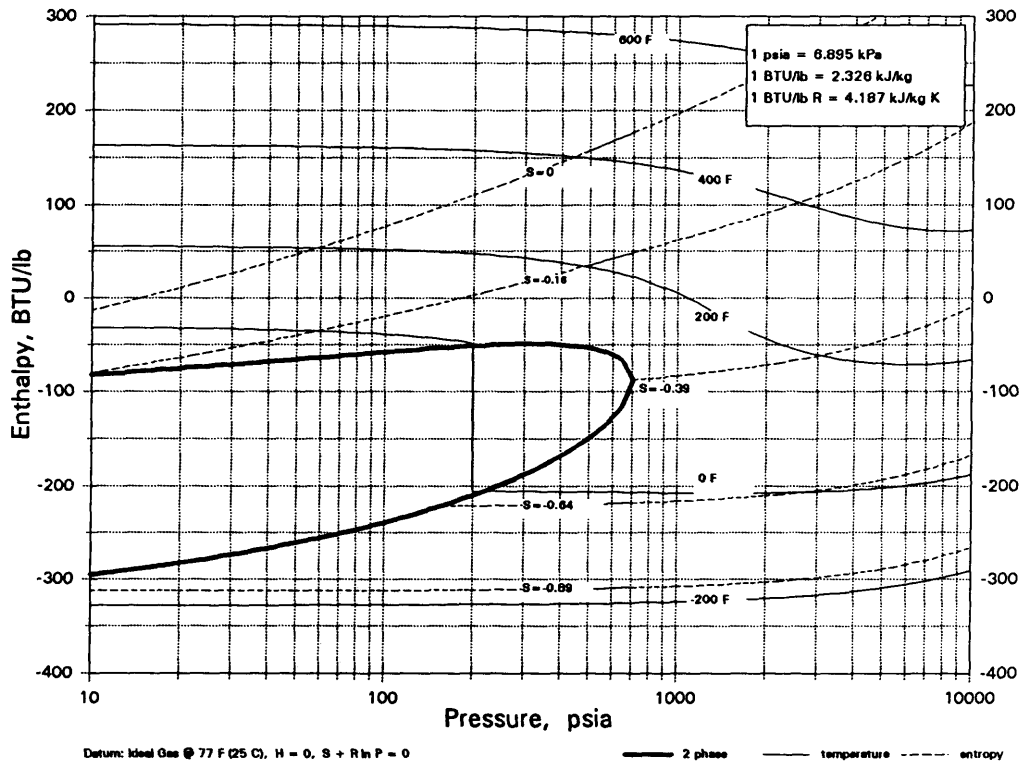
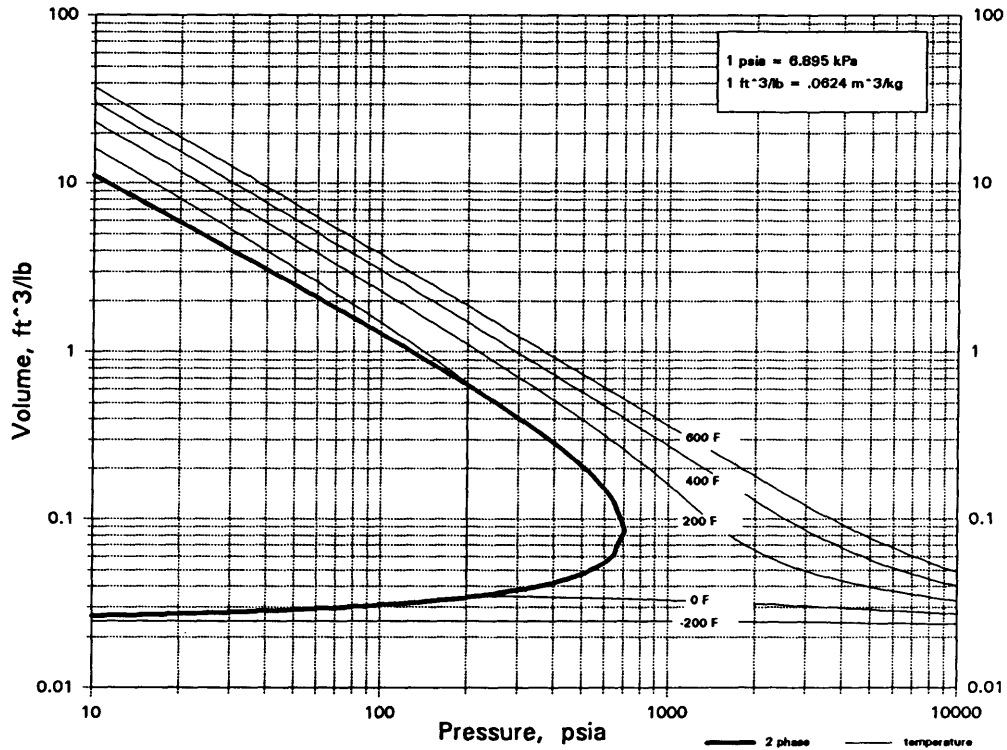
N-METHYLFORMAMIDE



C₂H₅NO₂ NITROETHANE

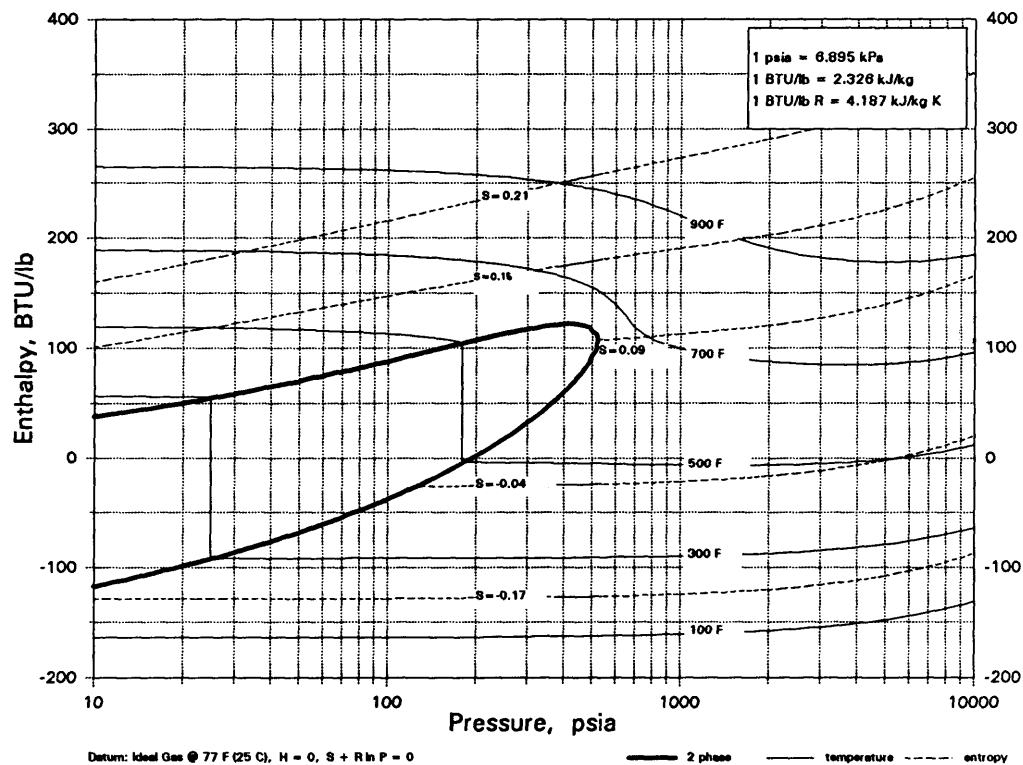
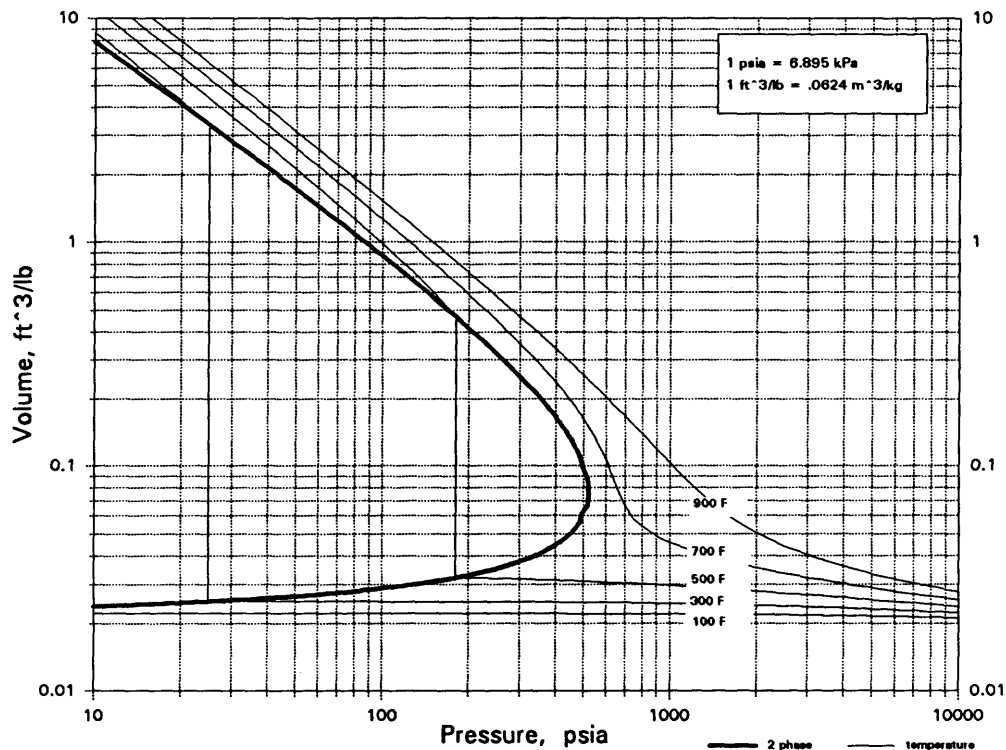


C2H6
ETHANE



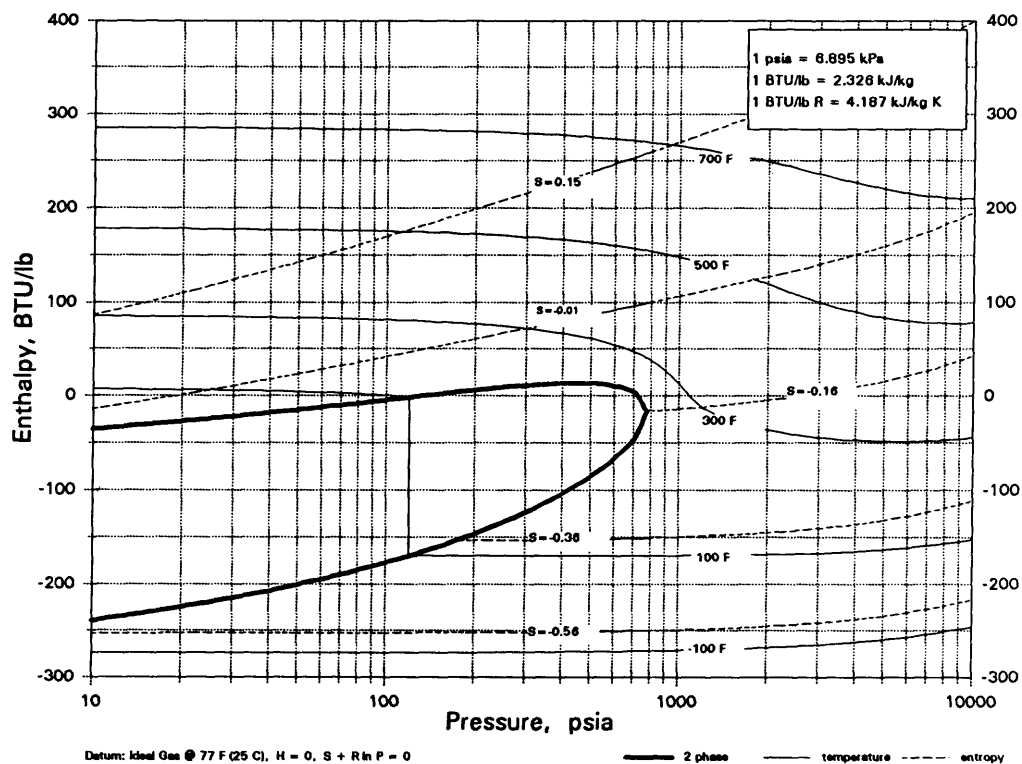
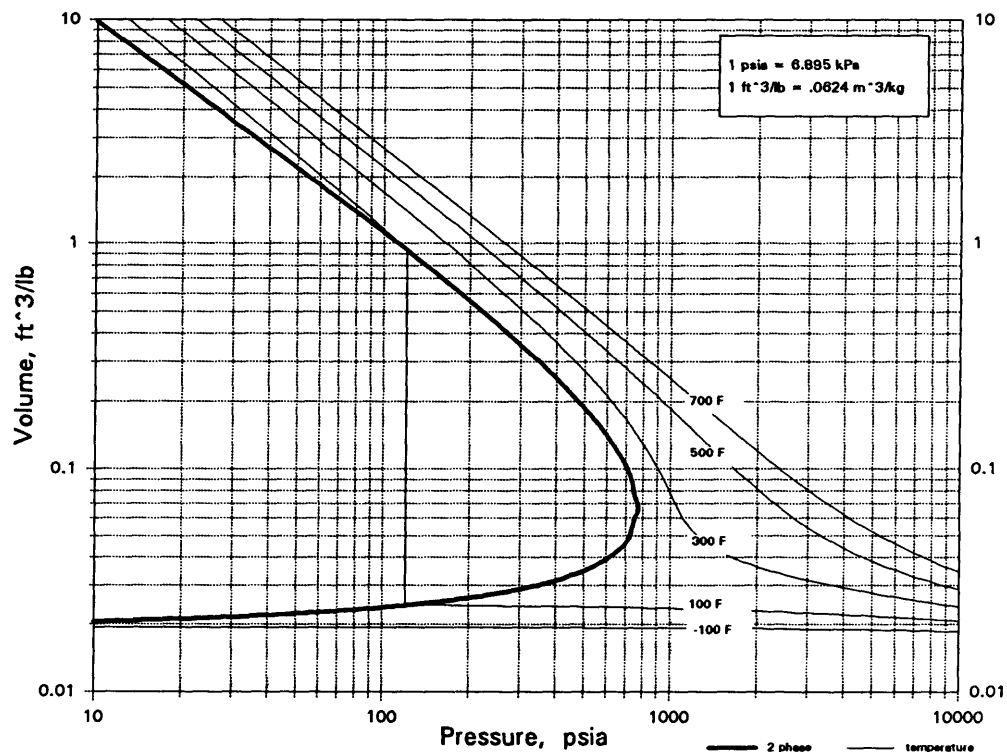
C₂H₆AlCl

DIMETHYLALUMINUM CHLORIDE

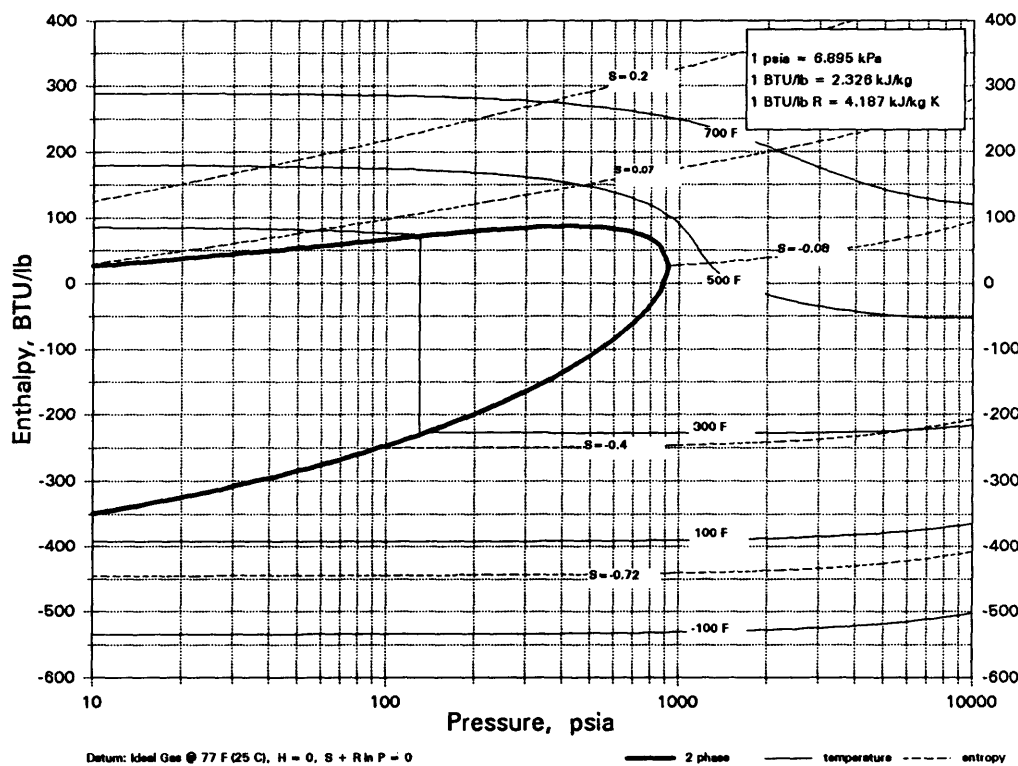
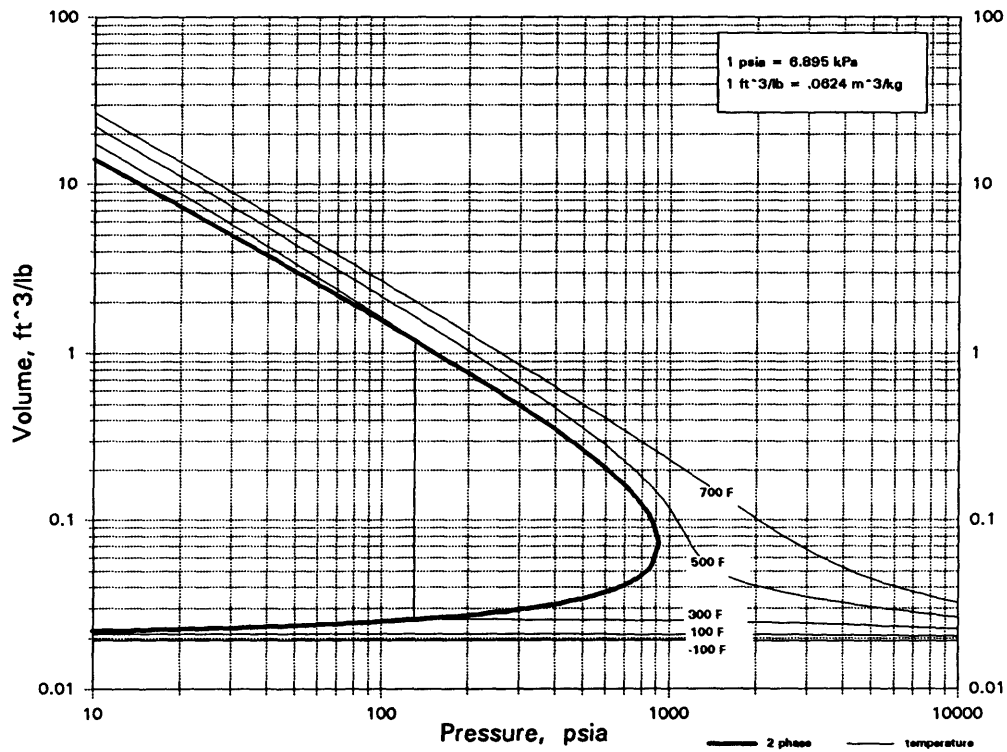


C₂H₆O

DIMETHYL ETHER

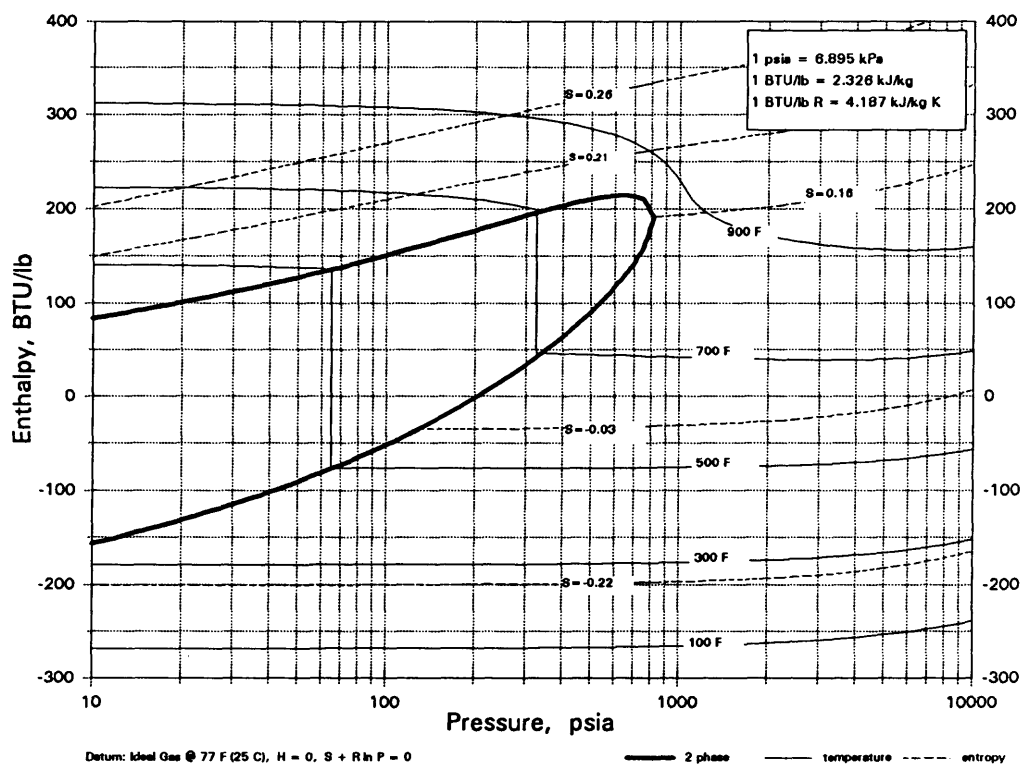
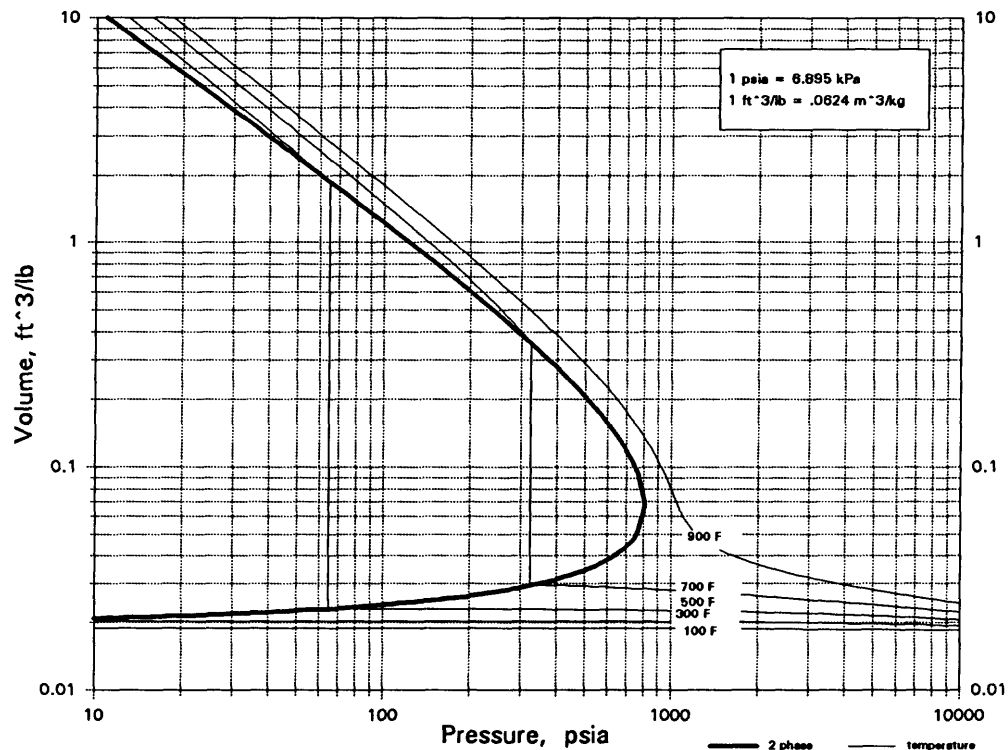


C2H6O
ETHANOL

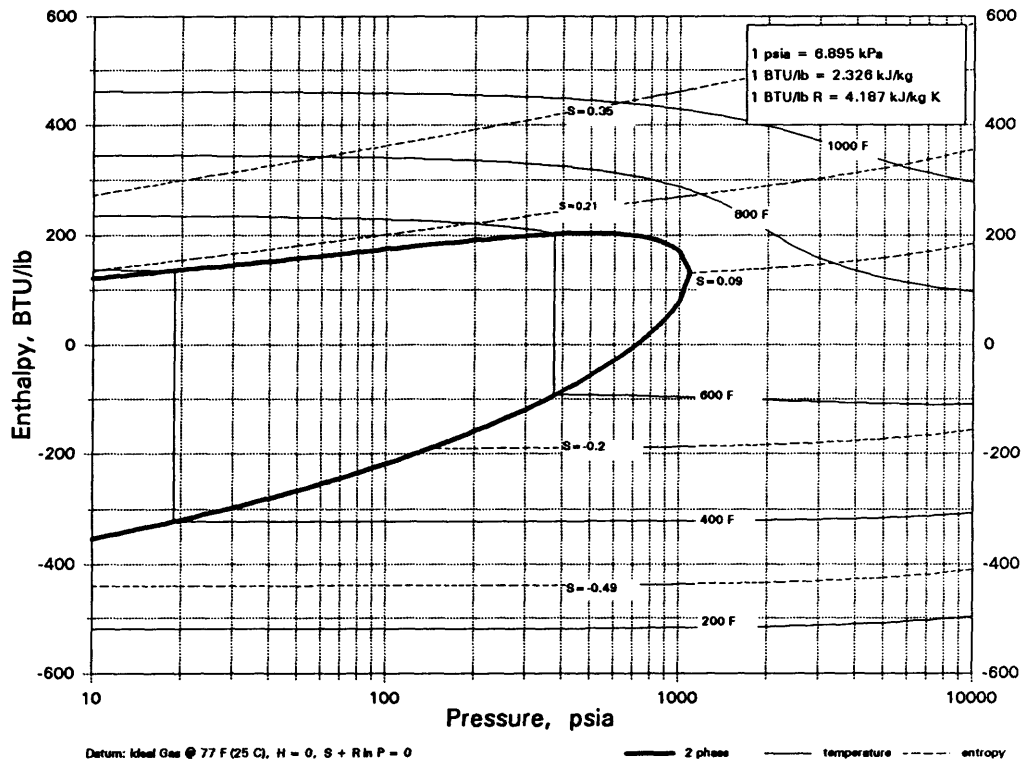
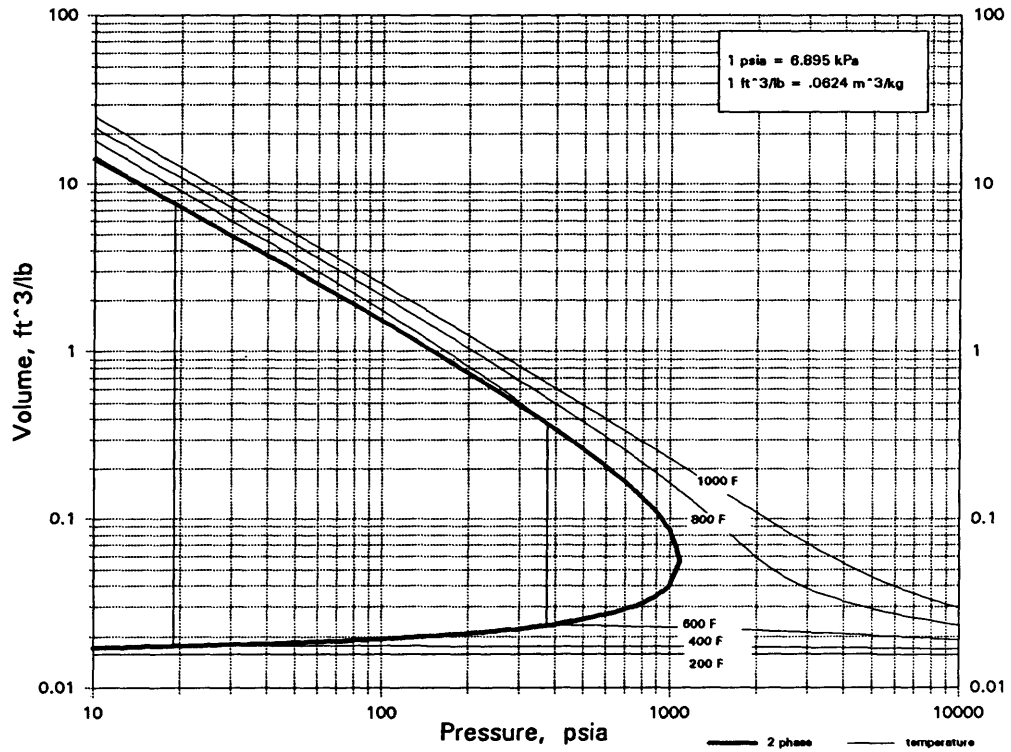


C2H6OS

DIMETHYL SULFOXIDE

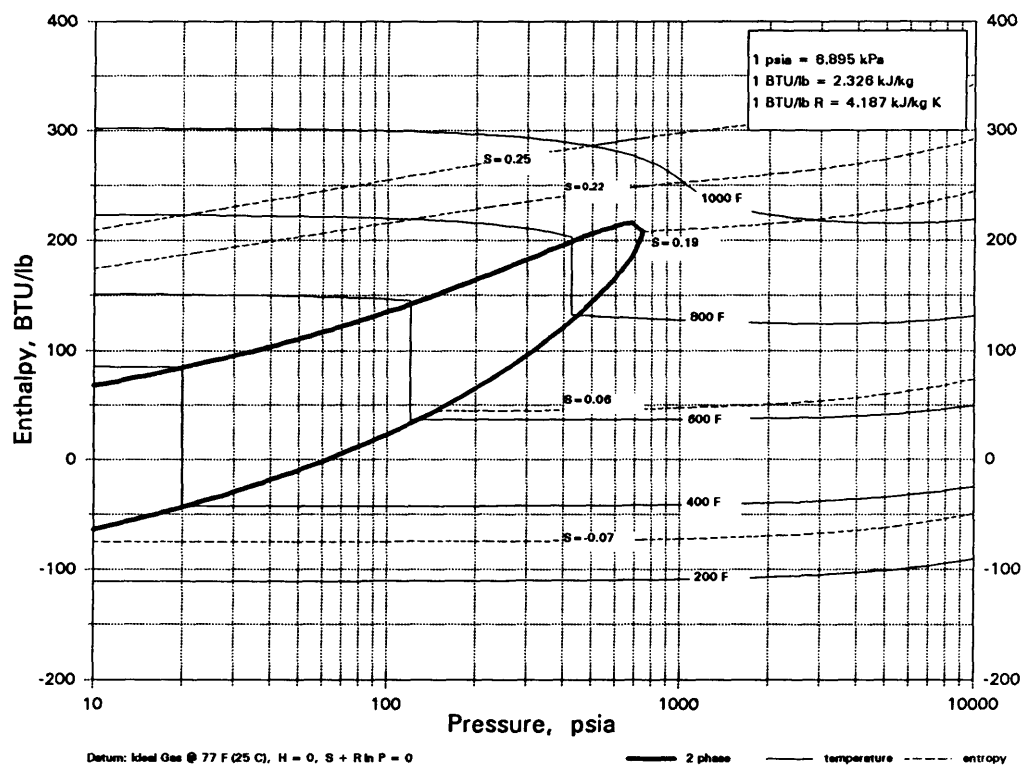
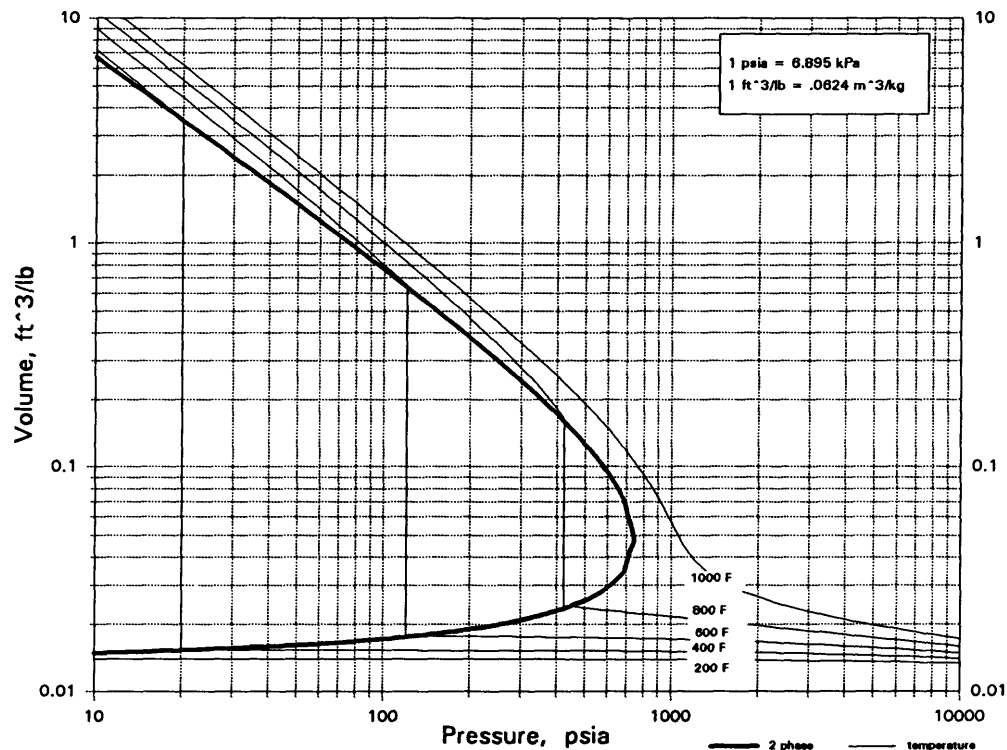


C2H6O2
ETHYLENE GLYCOL



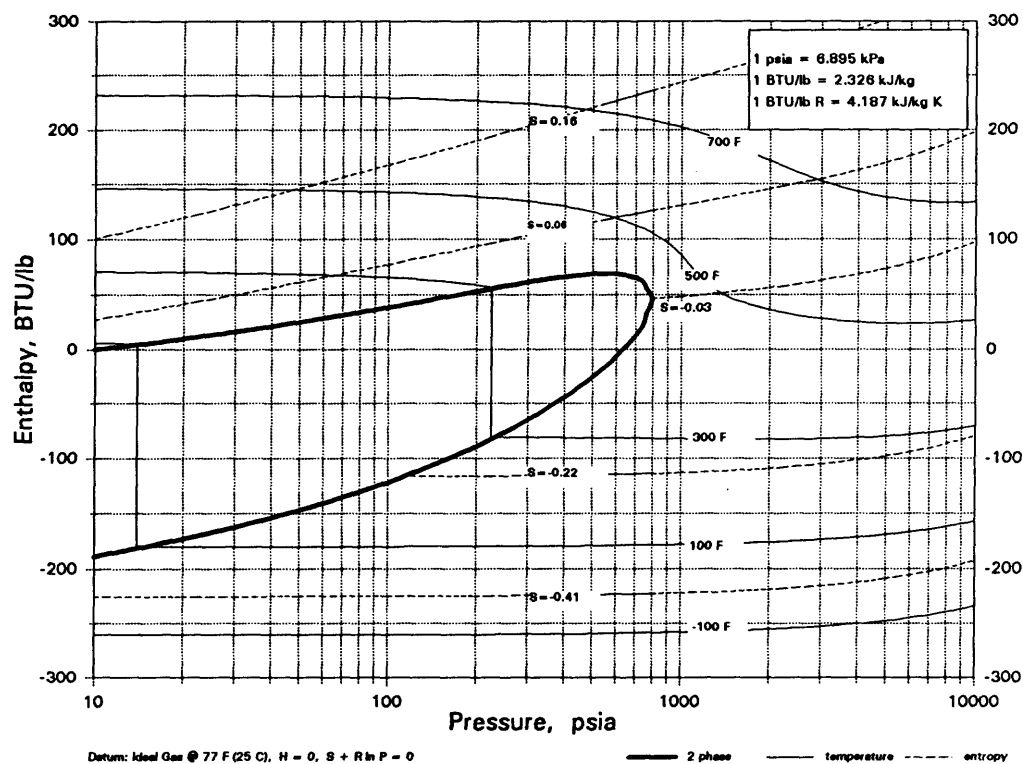
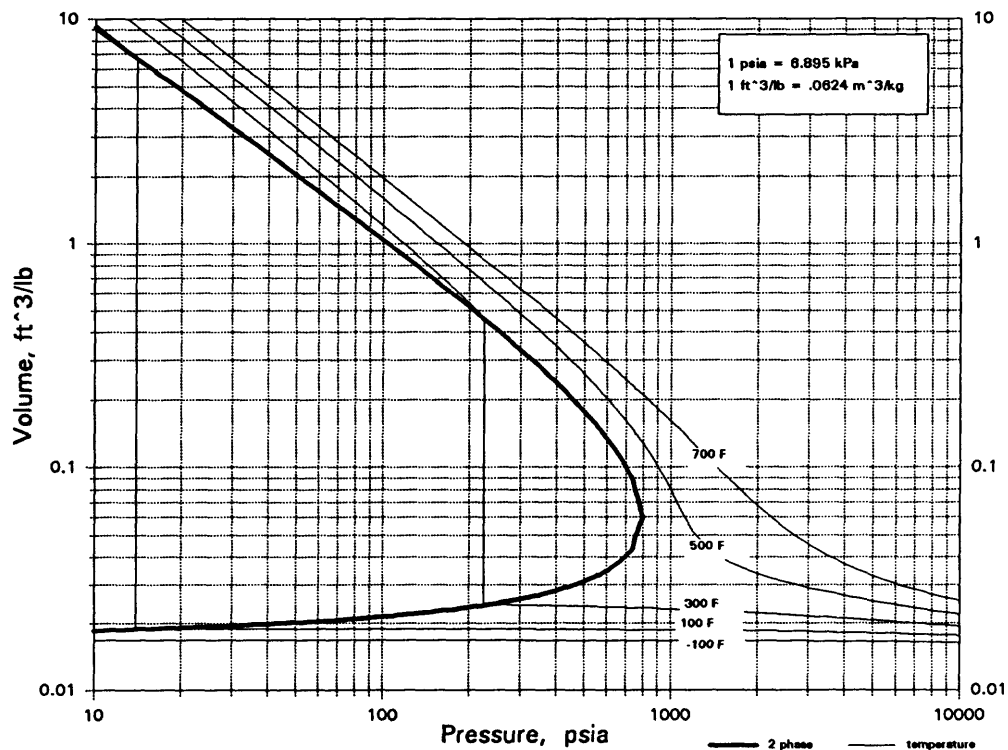
C2H6O4S

DIMETHYL SULFATE

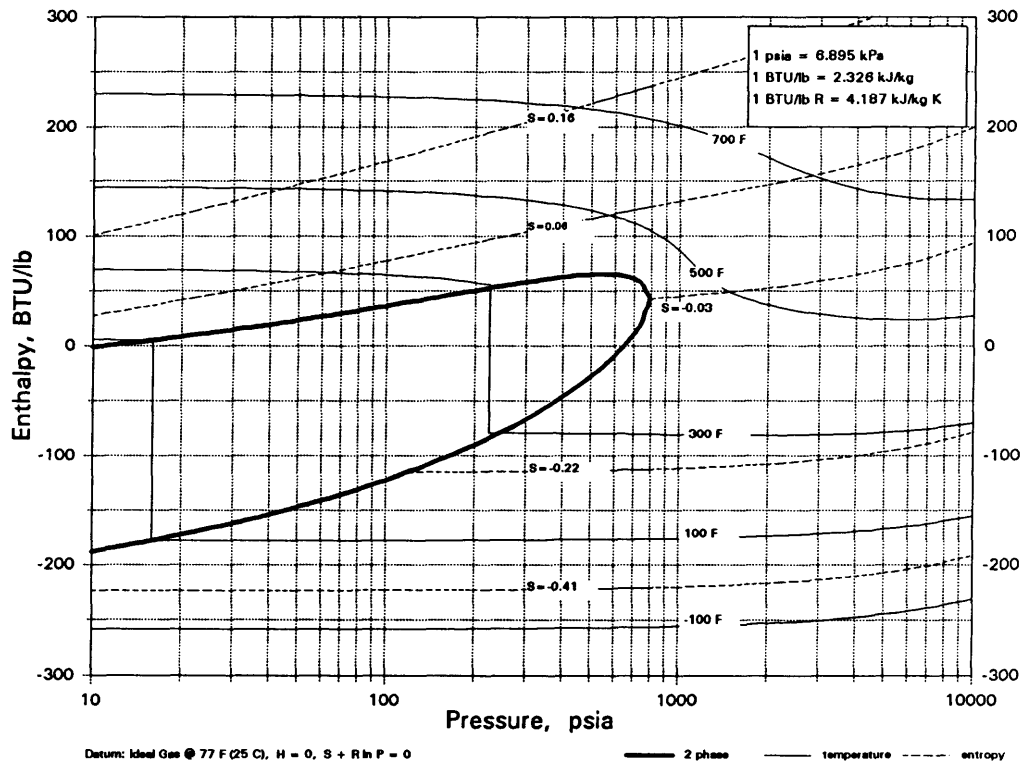
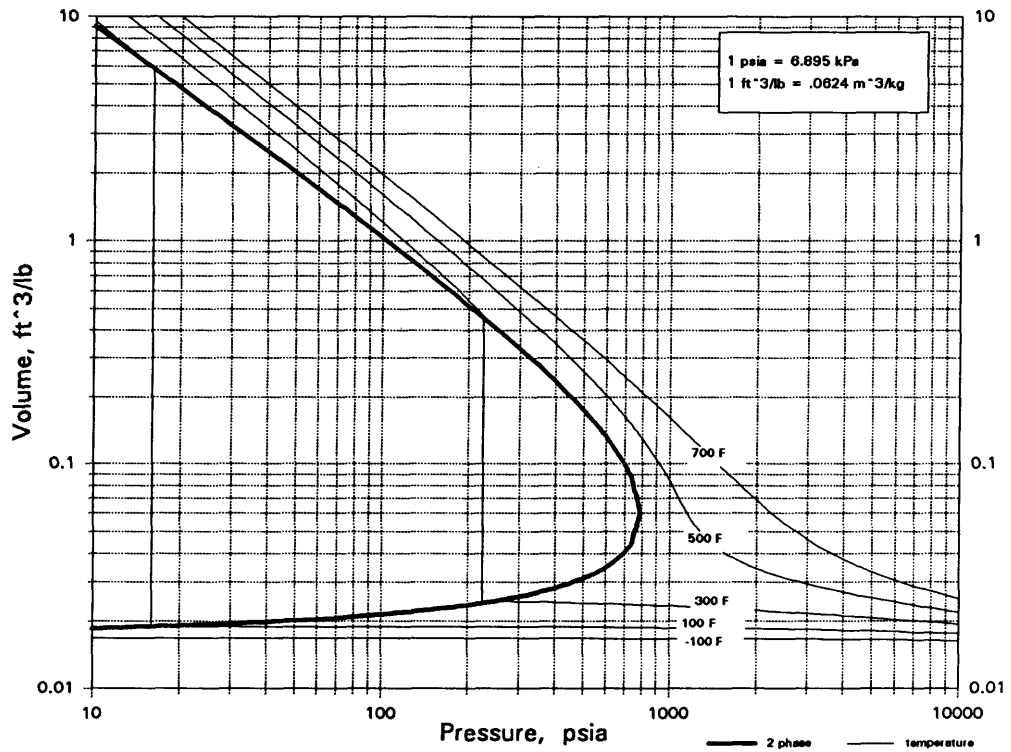


C2H6S

DIMETHYL SULFIDE

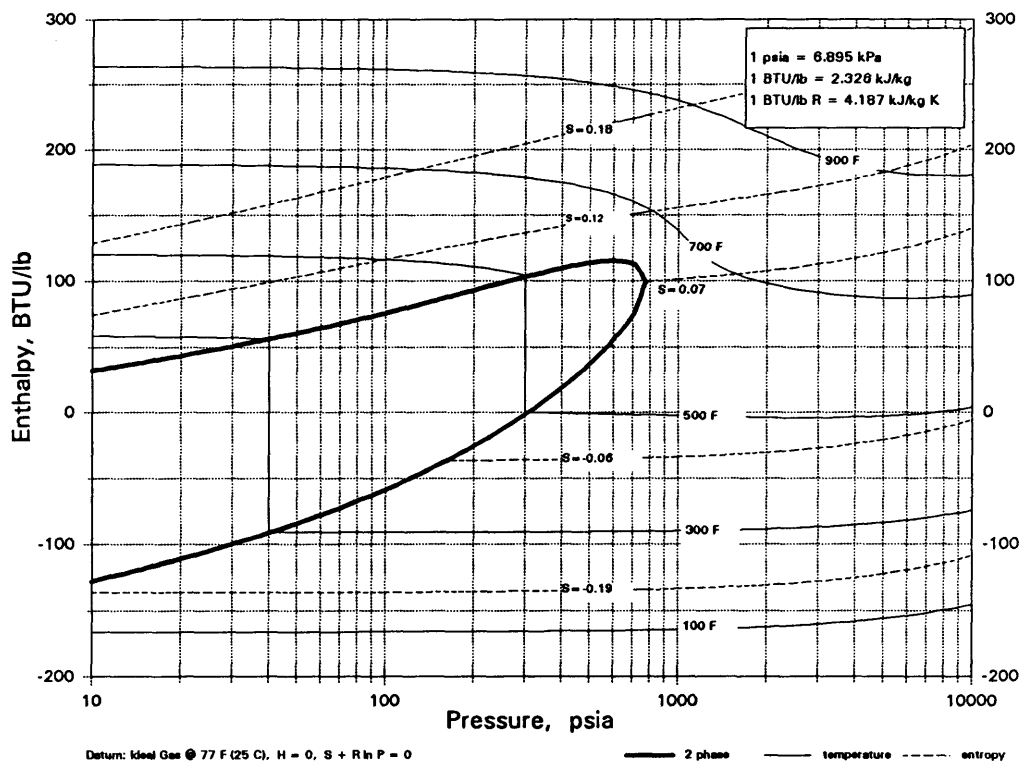
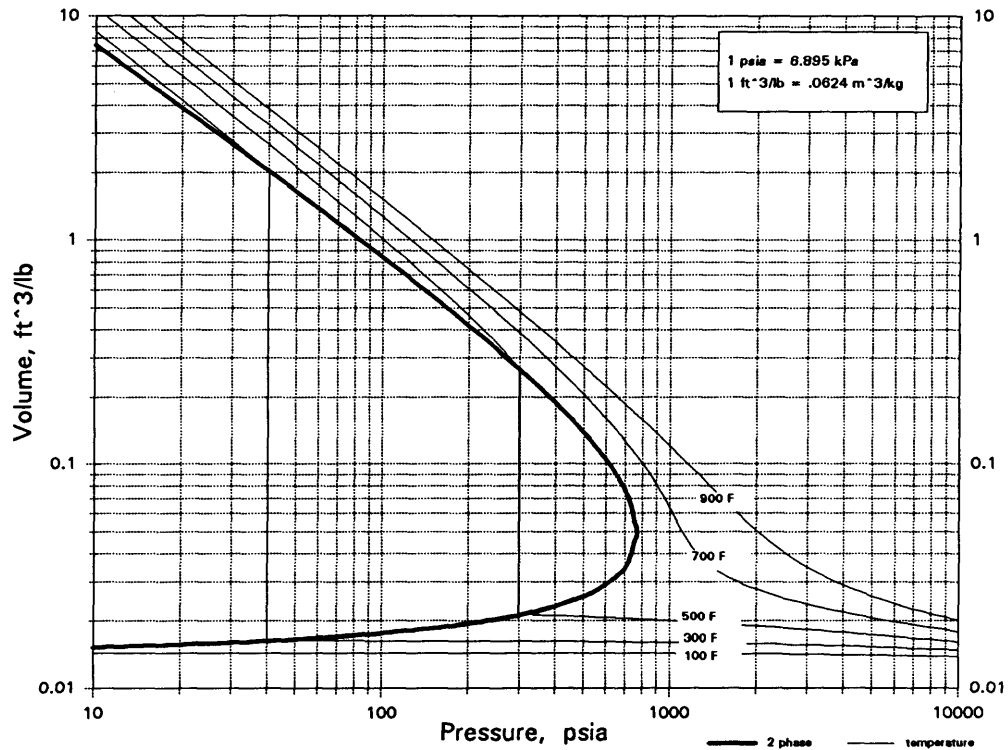


C2H6S
ETHYL MERCAPTAN

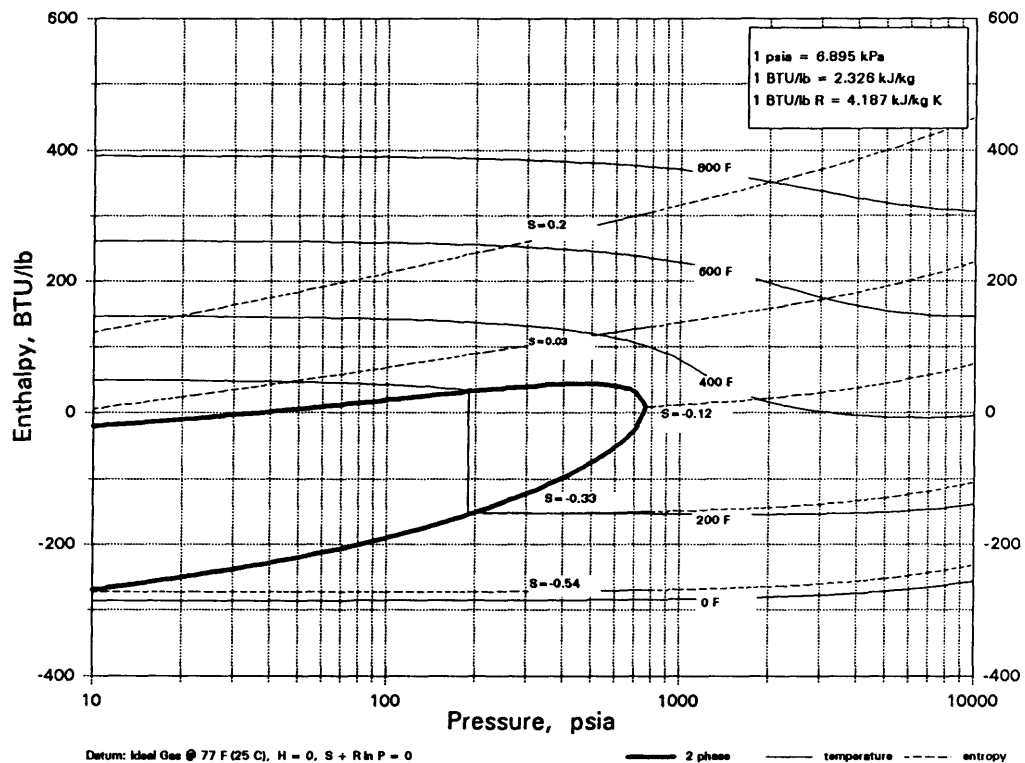
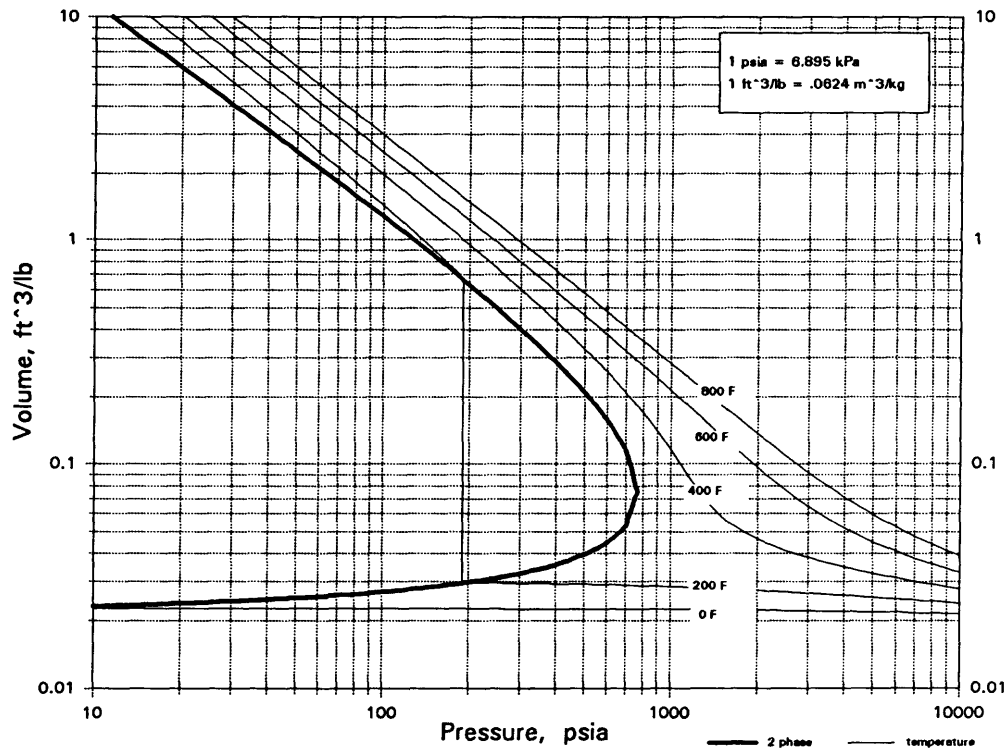


C2H6S2

DIMETHYL DISULFIDE

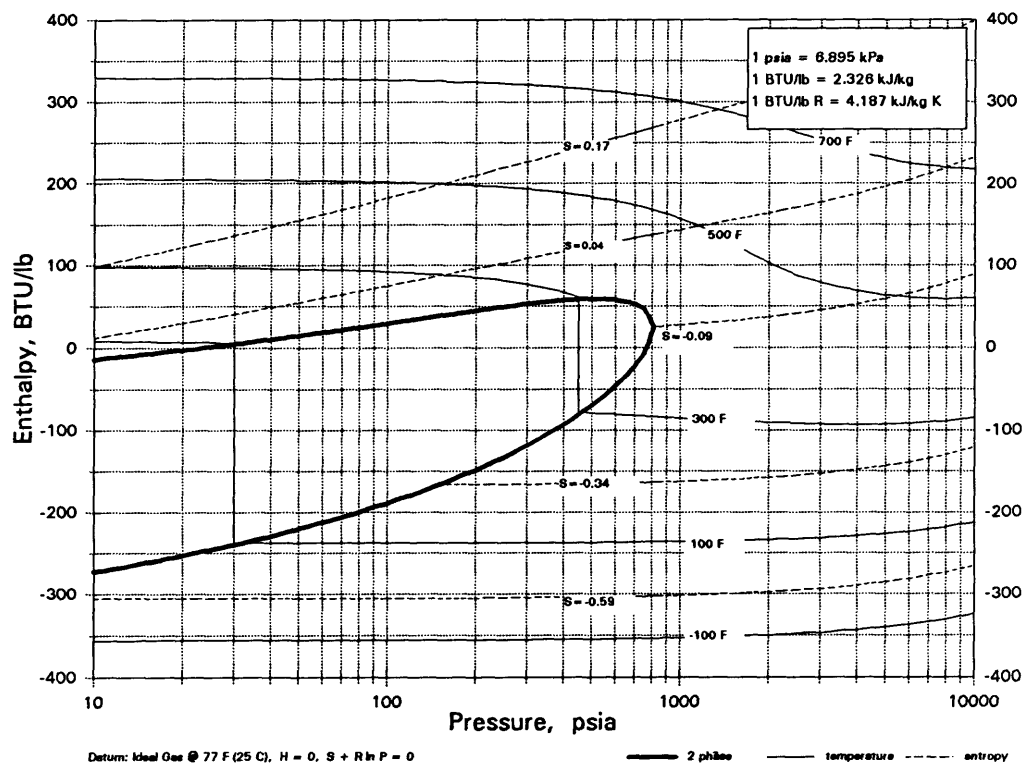
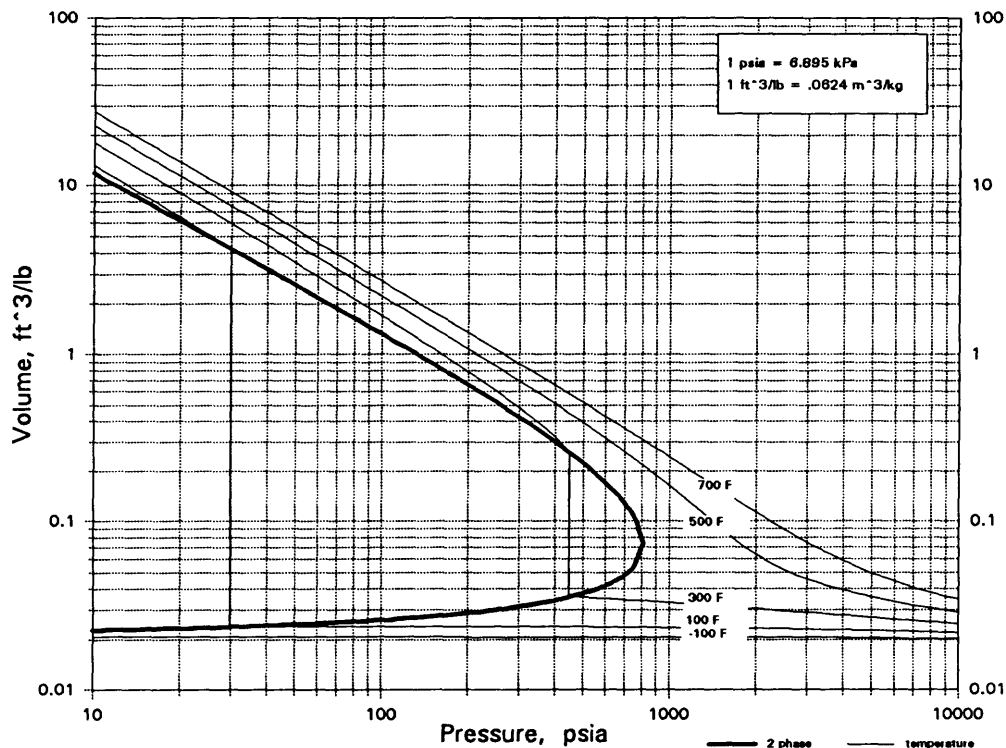


C2H7N
DIMETHYLAMINE



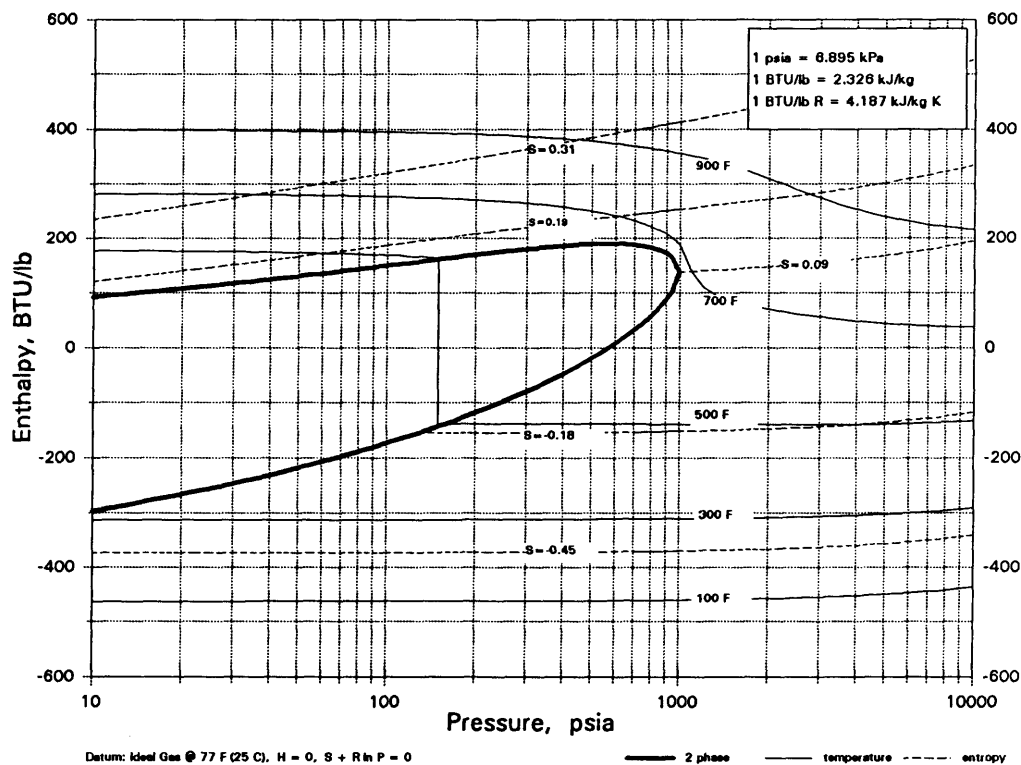
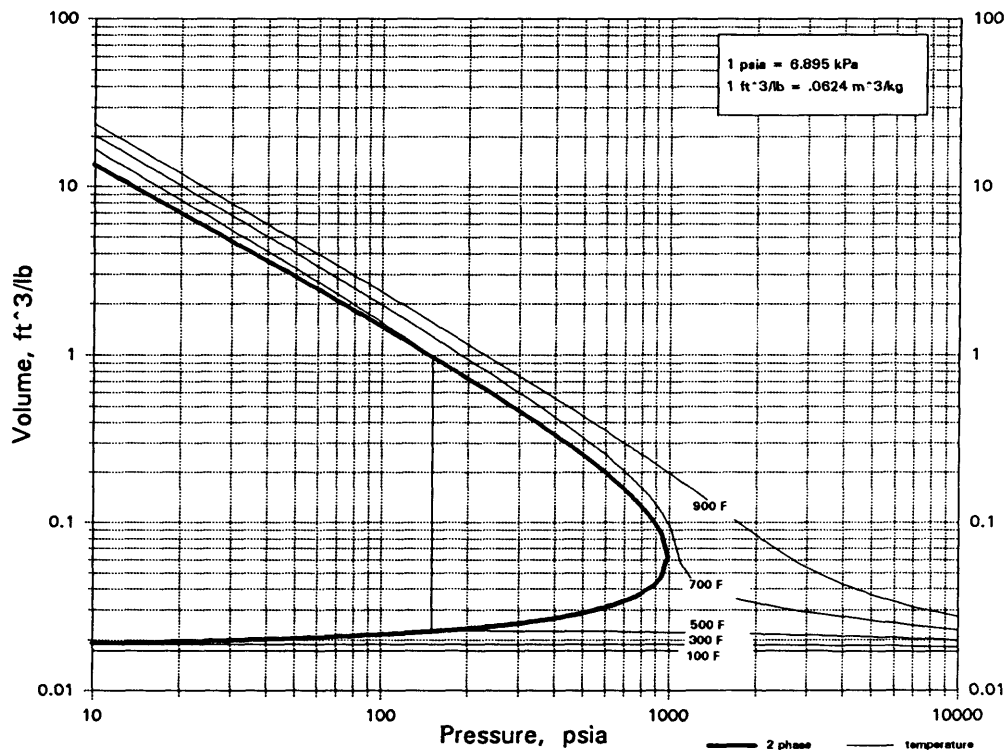
C₂H₇N

ETHYLAMINE

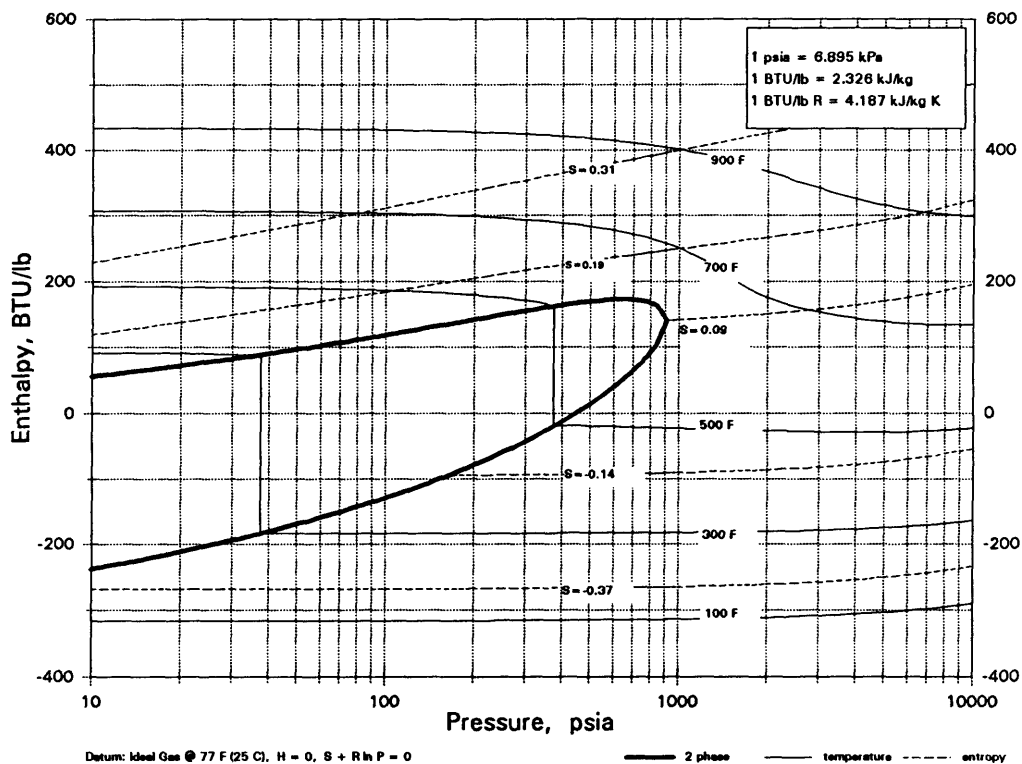
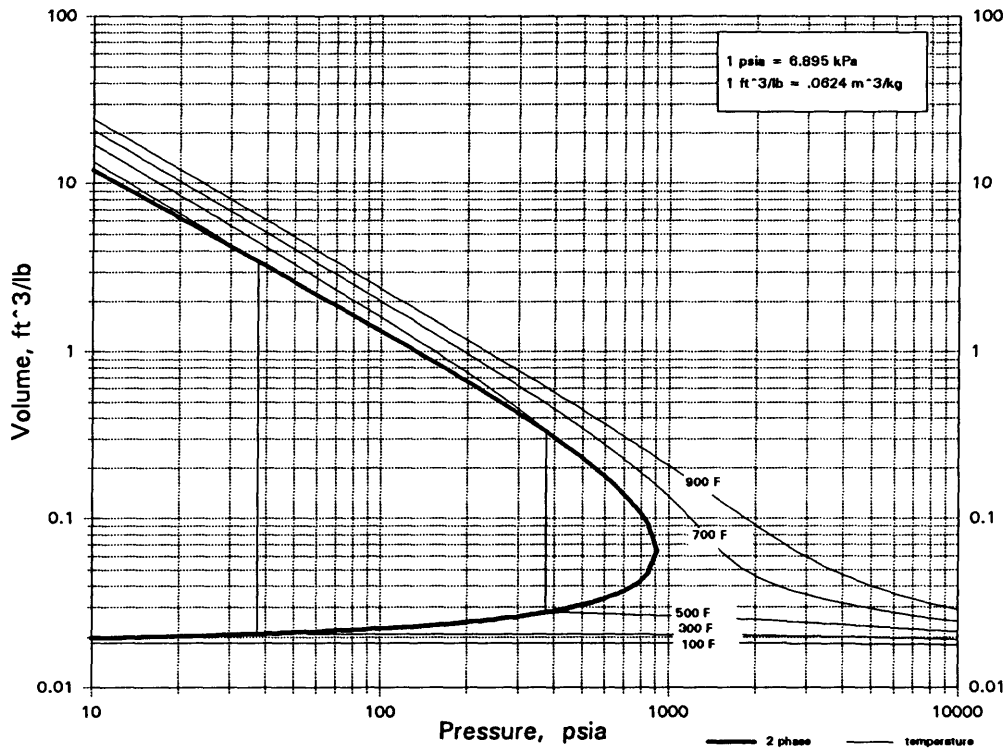


C₂H₇NO

MONOETHANOLAMINE

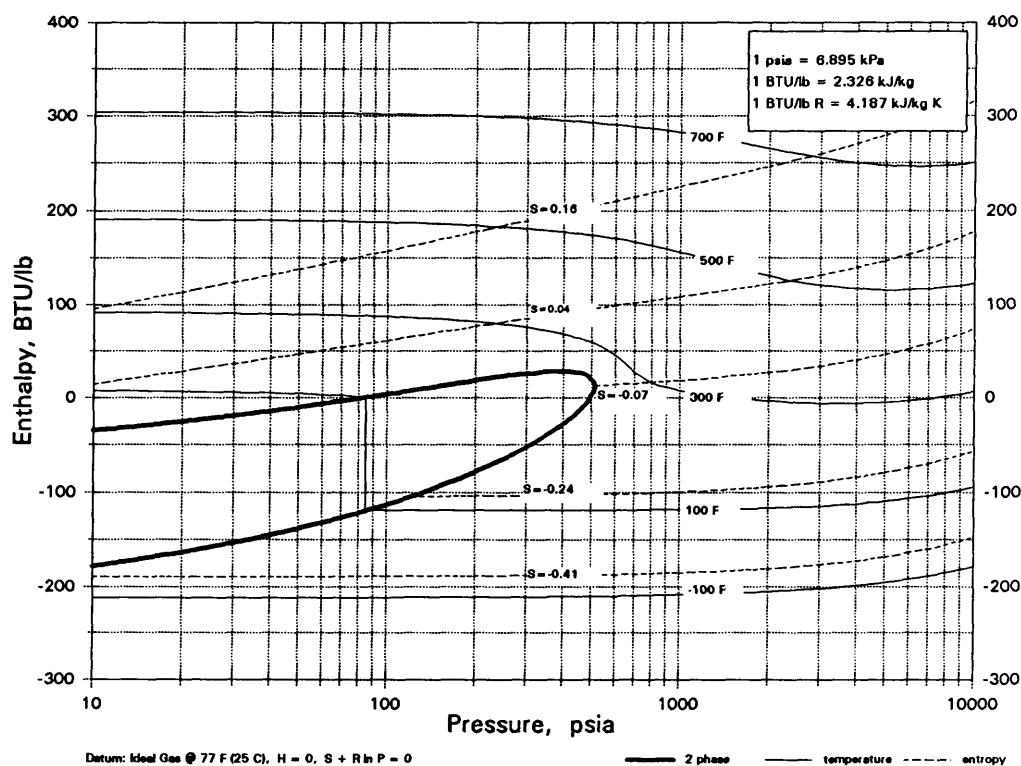
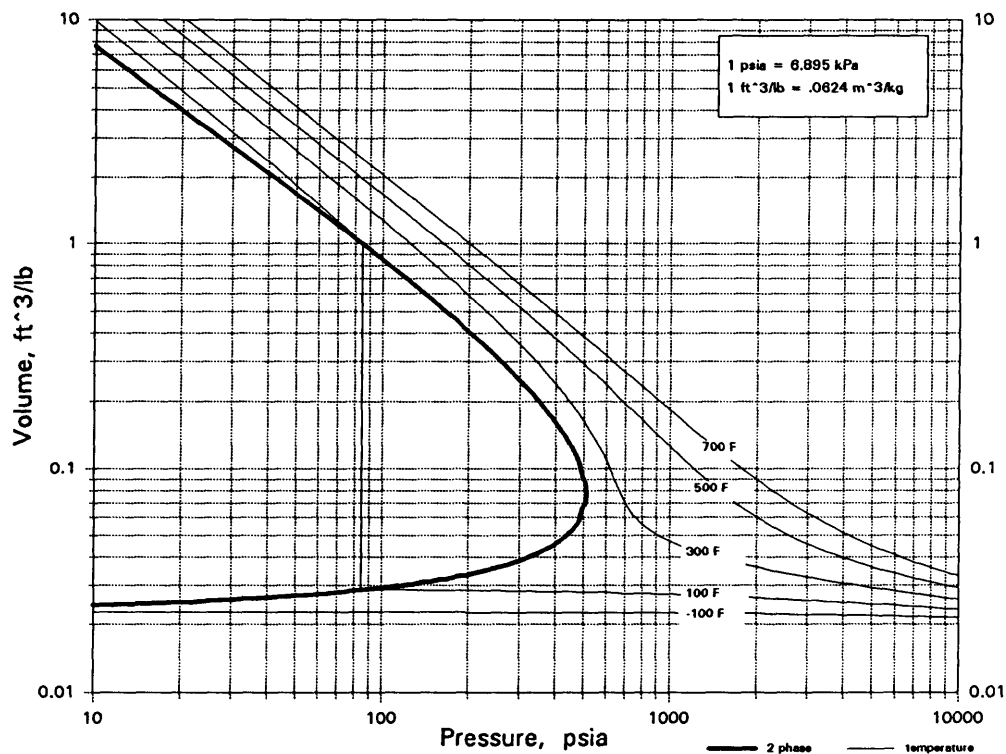


C2H8N2
ETHYLENEDIAMINE



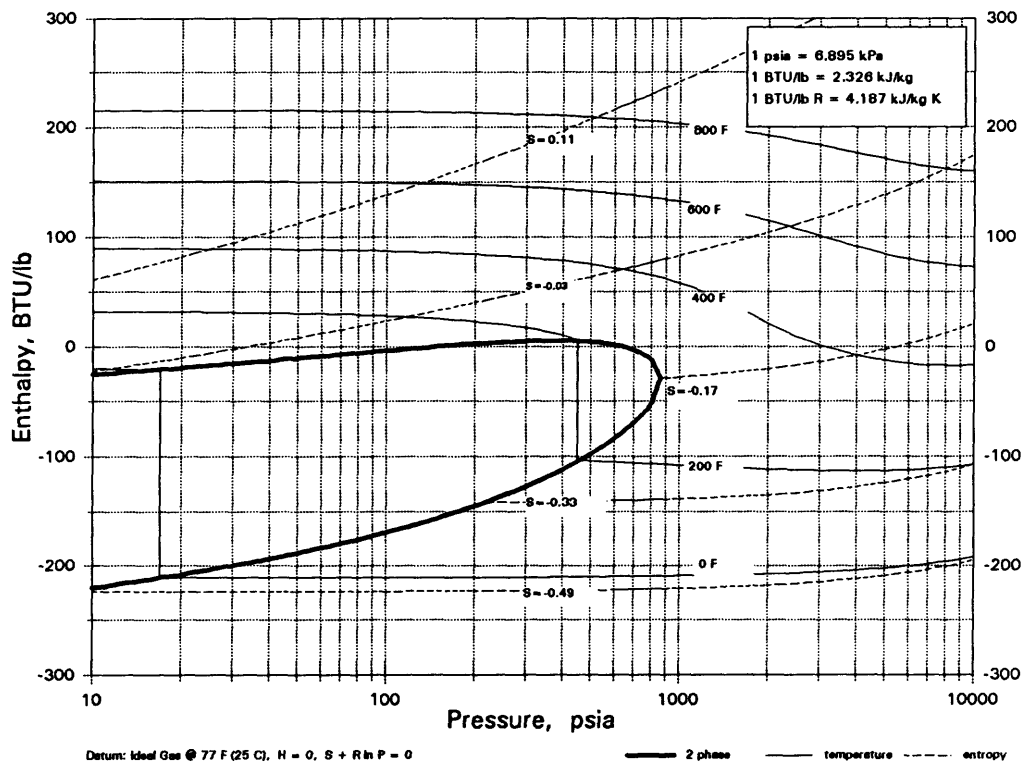
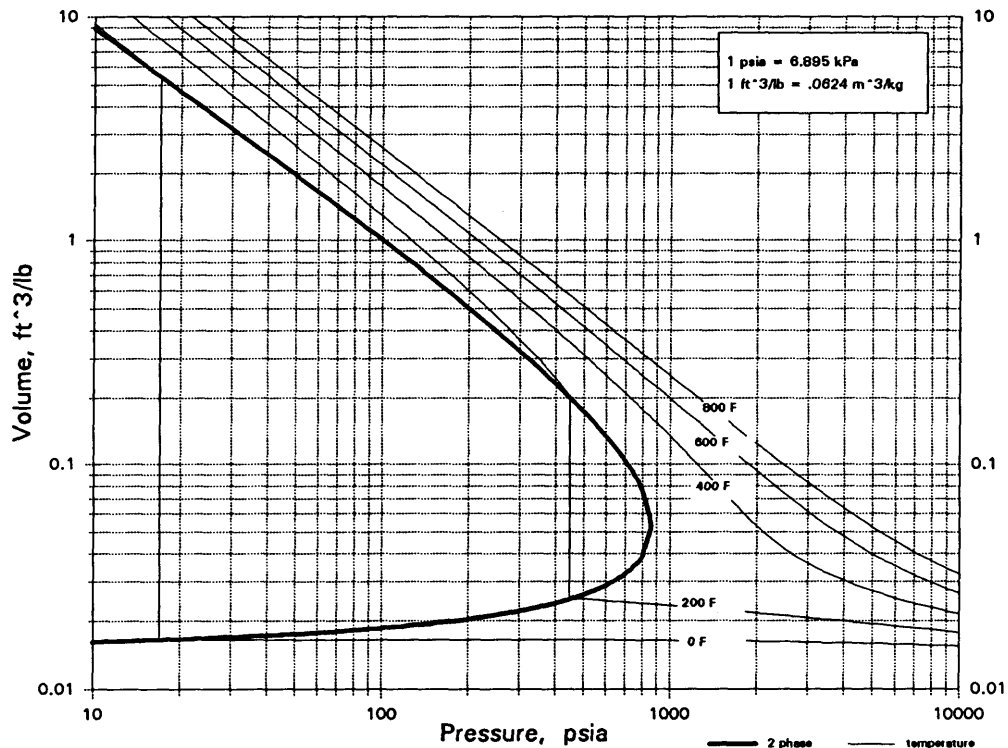
C₂H₆Si

DIMETHYL SILANE



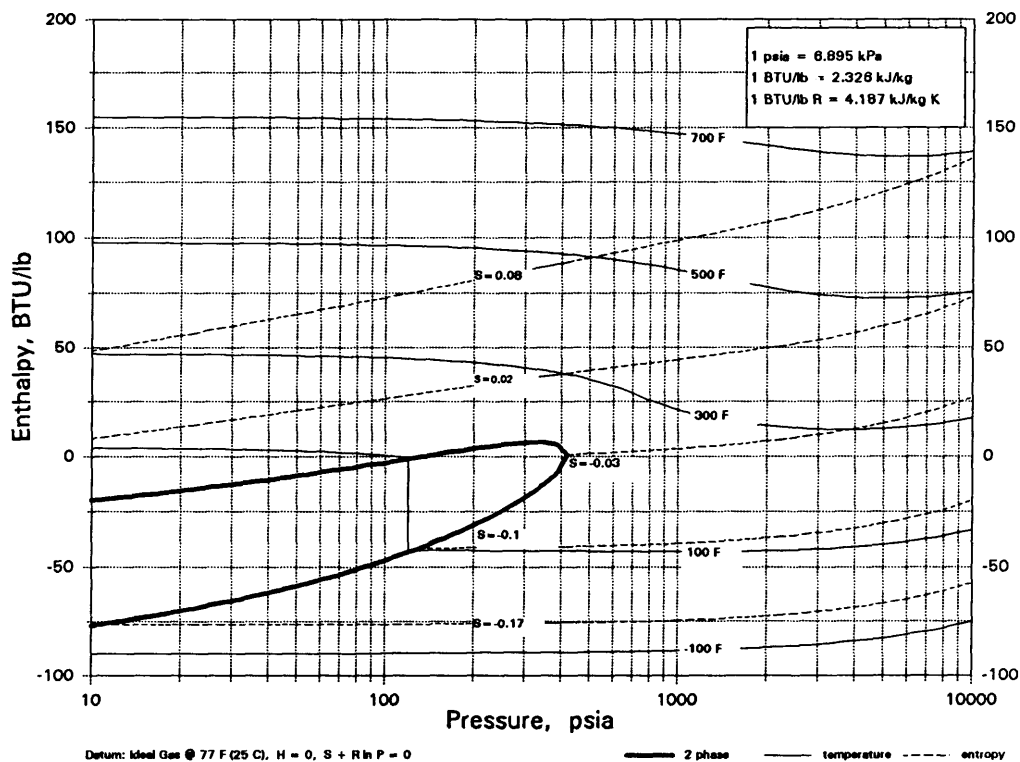
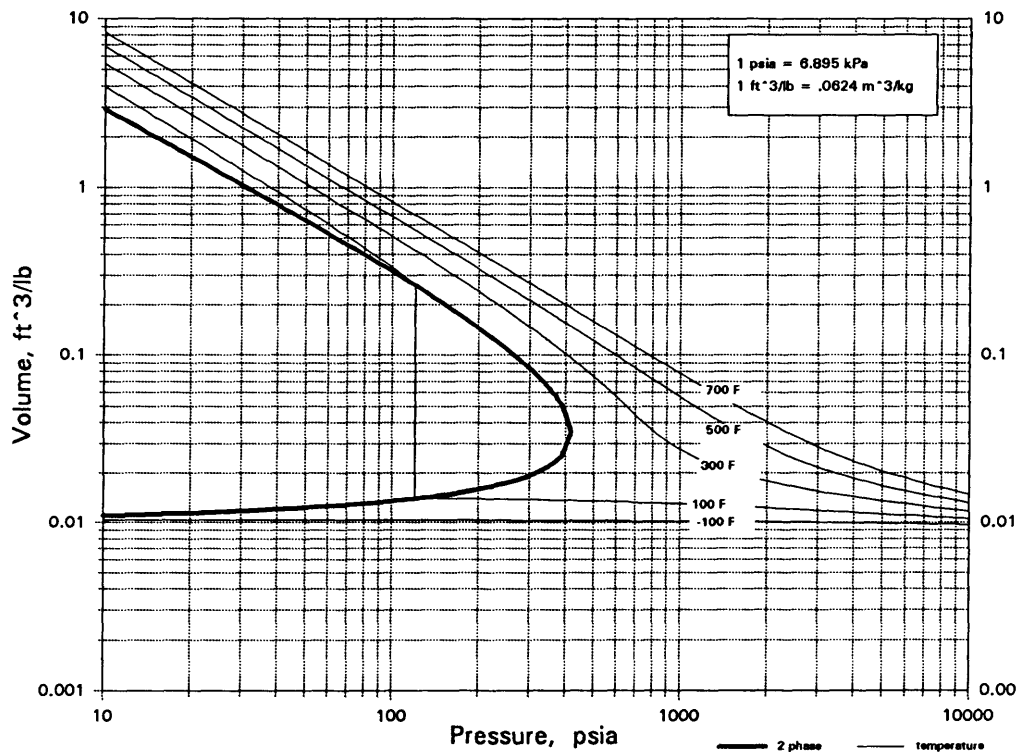
C2N2

CYANOGEN



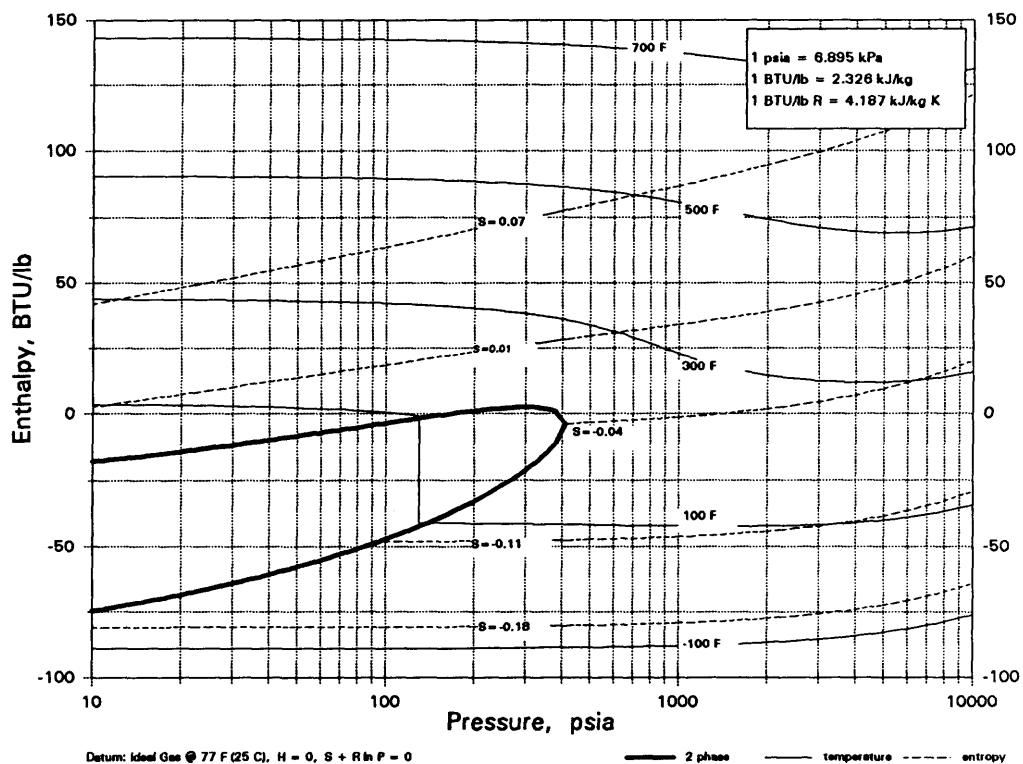
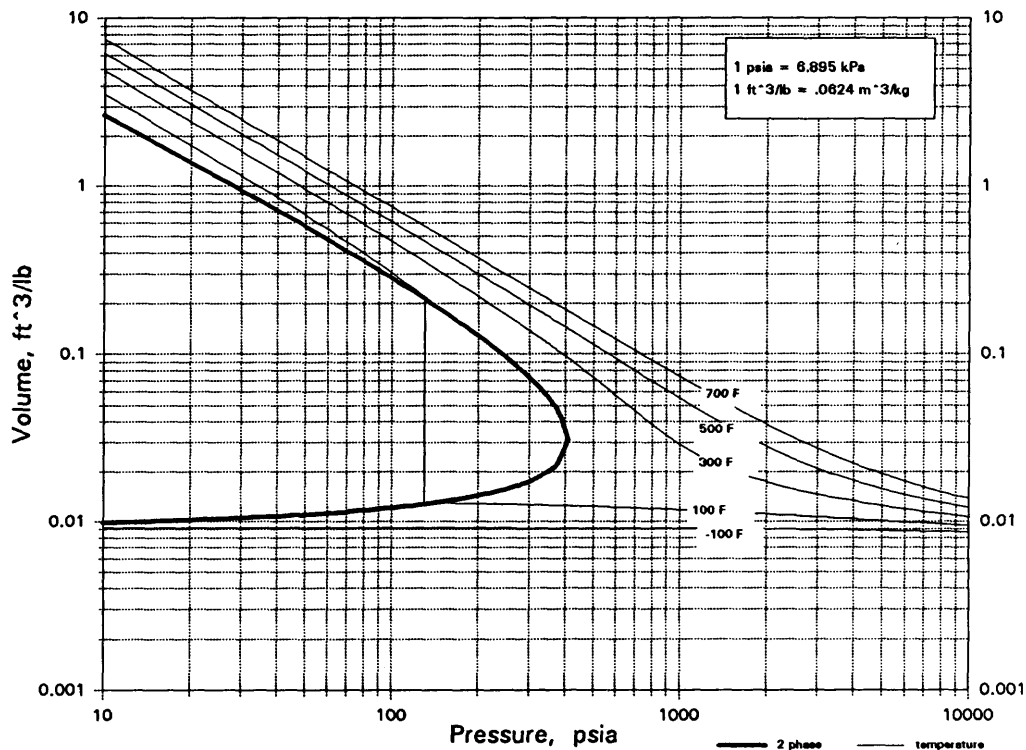
C3F6

HEXAFLUOROPROPYLENE



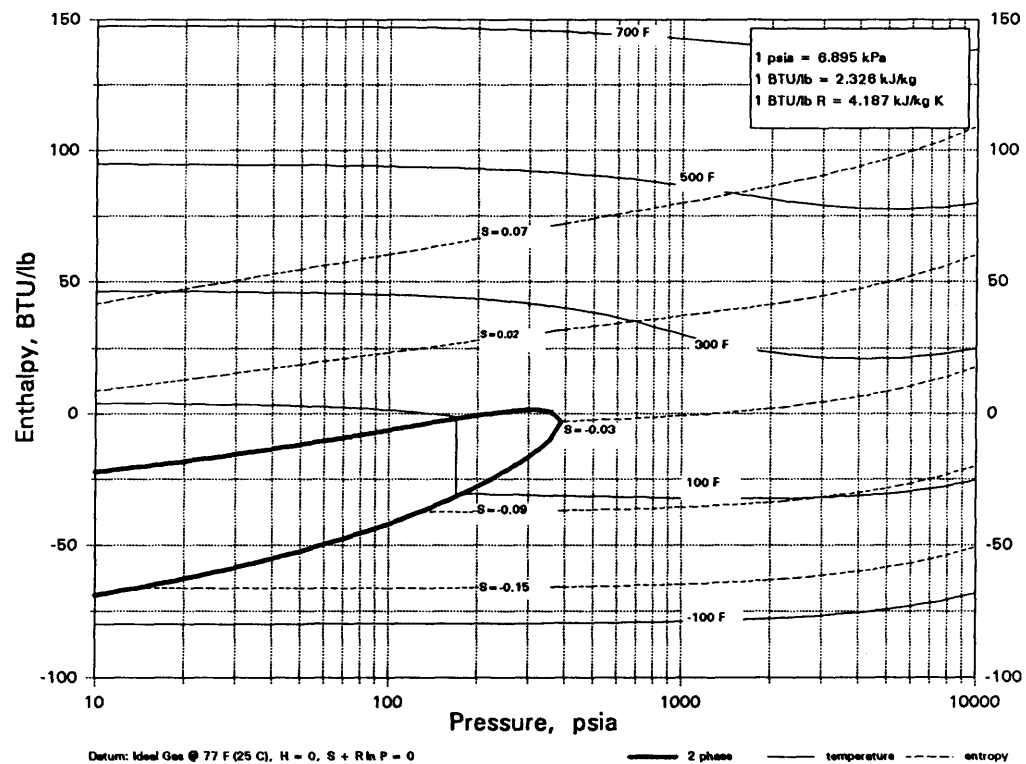
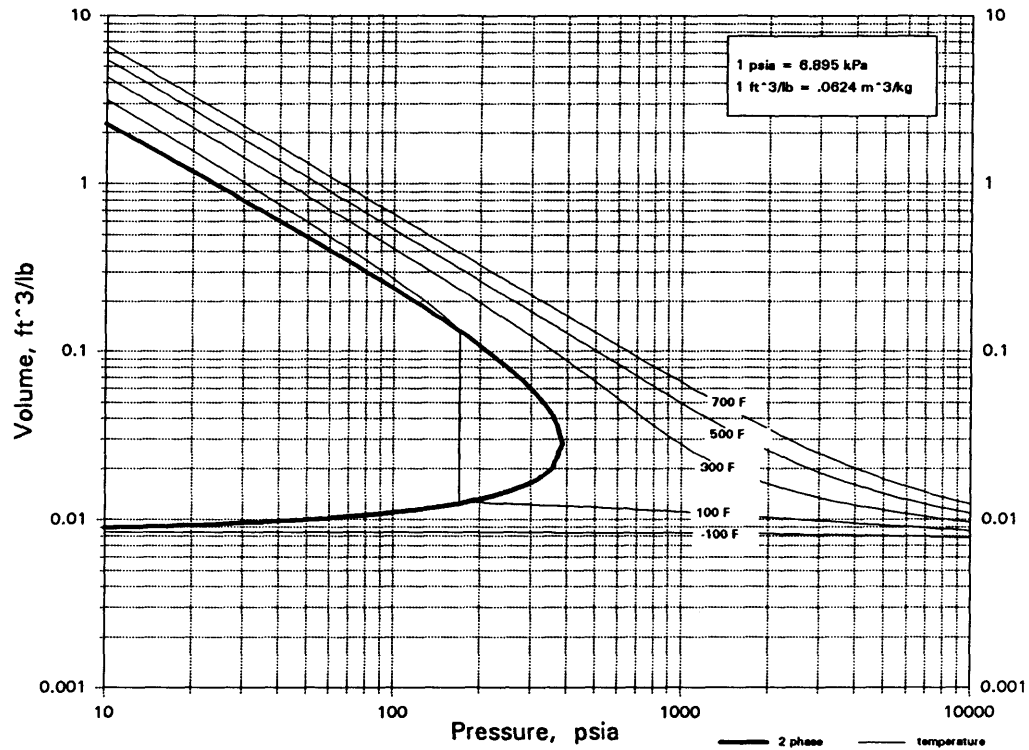
C3F6O

HEXAFLUOROACETONE

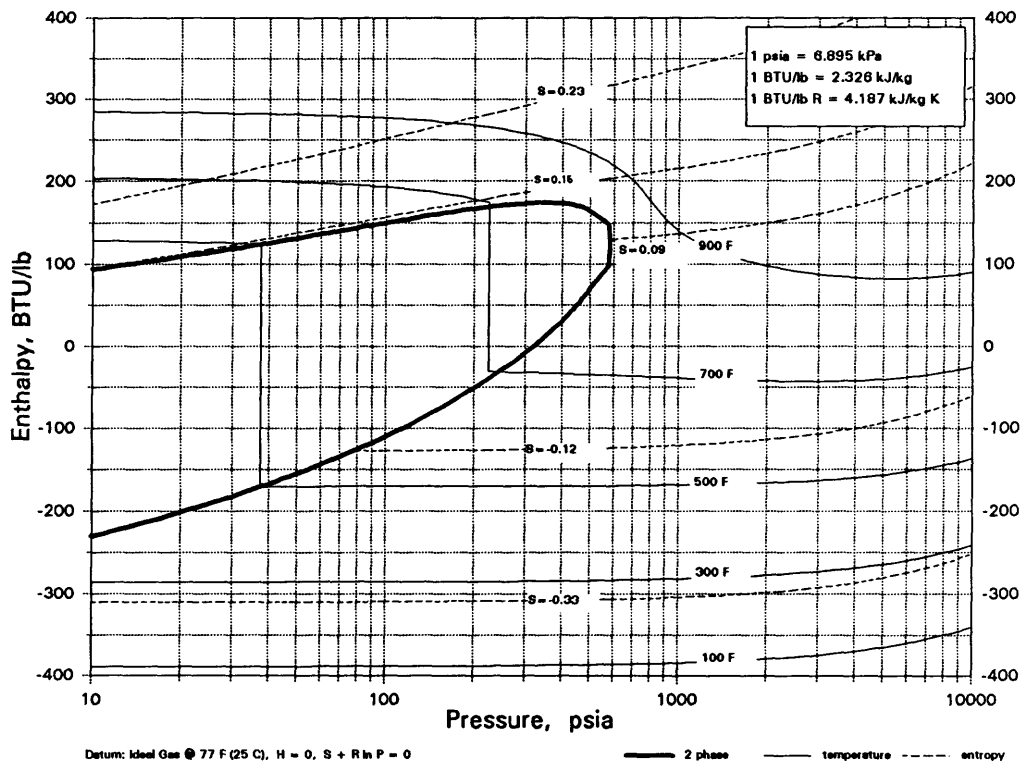
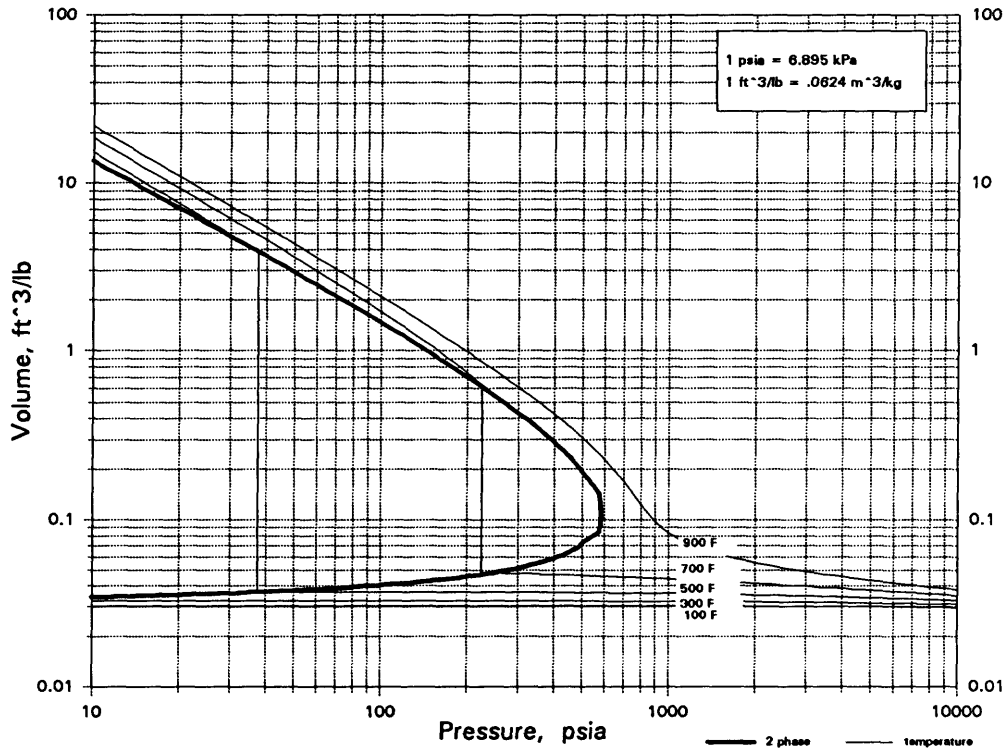


C3F8

OCTAFLUOROPROPANE

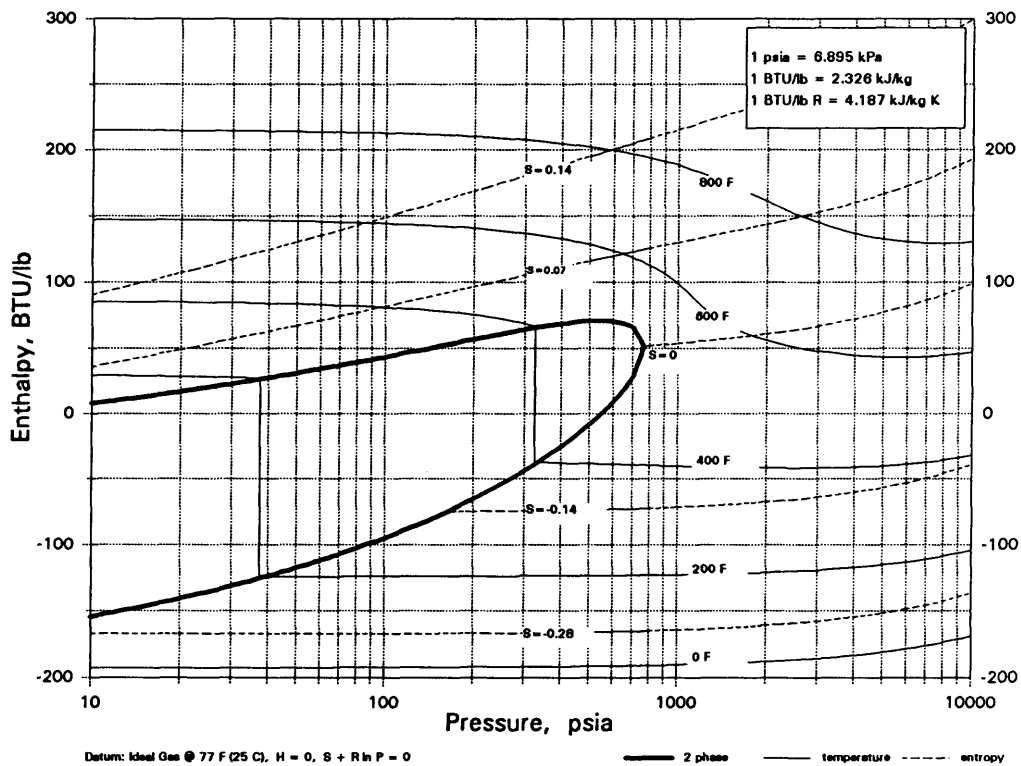
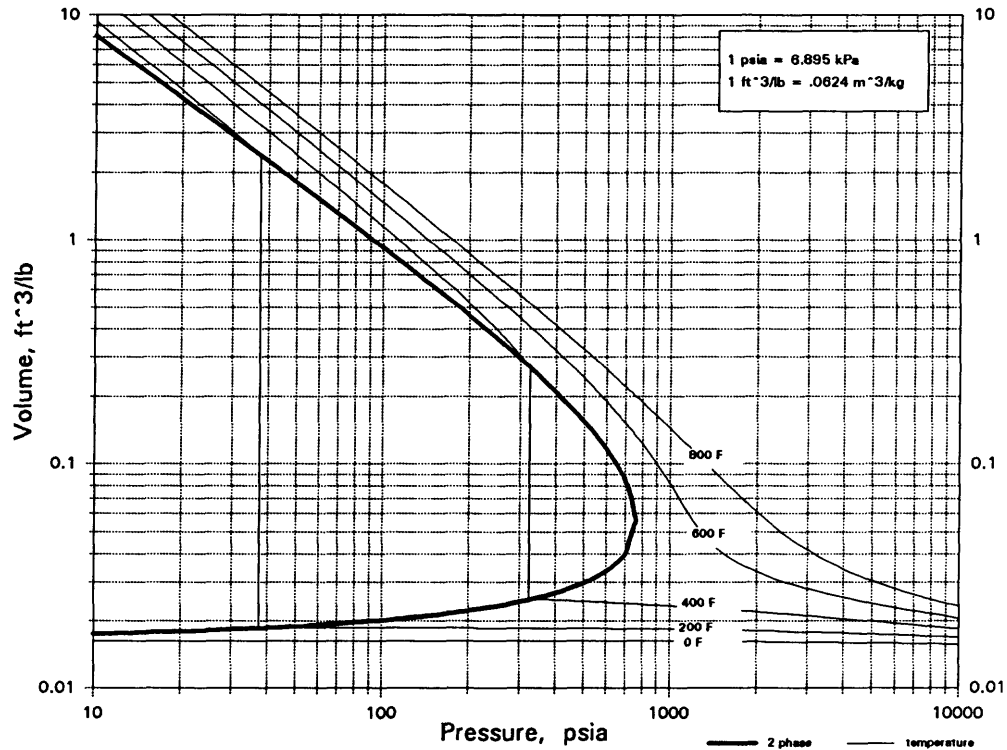


C₃H₂N₂
MALONONITRILE



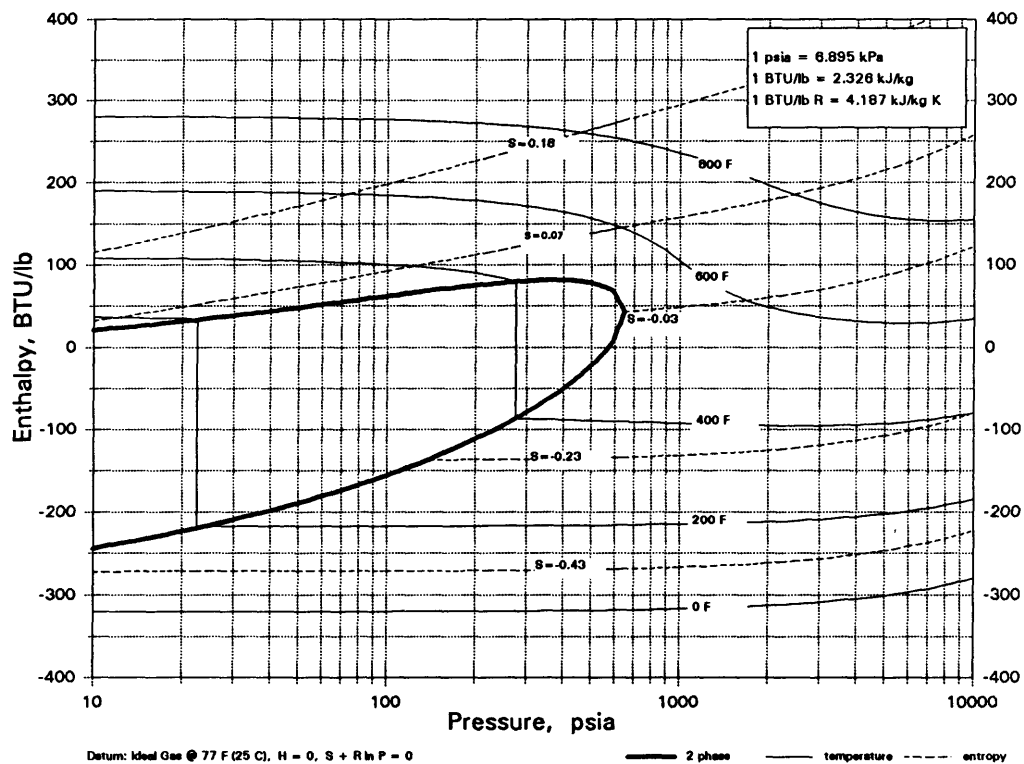
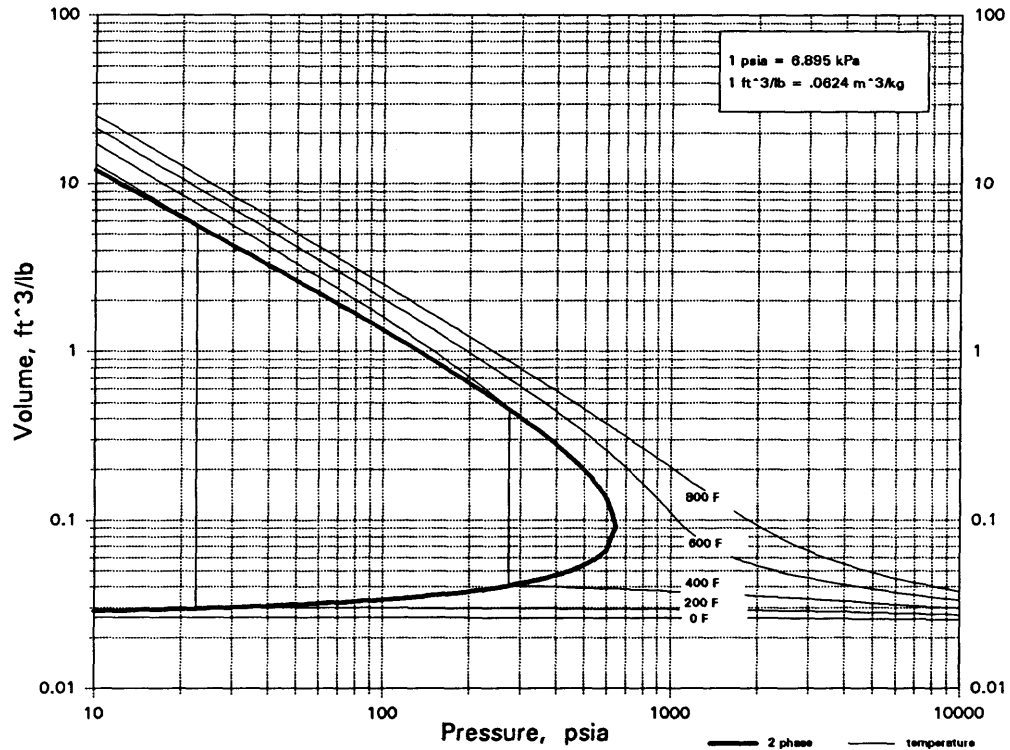
C3H3Cl

PROPARGYL CHLORIDE



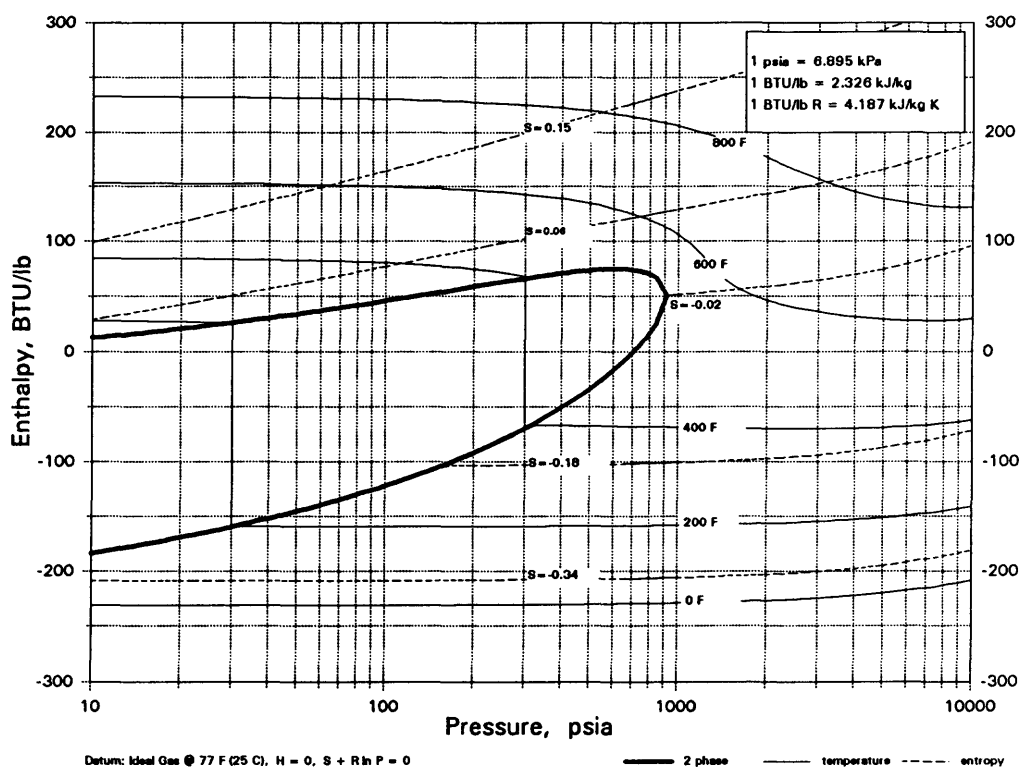
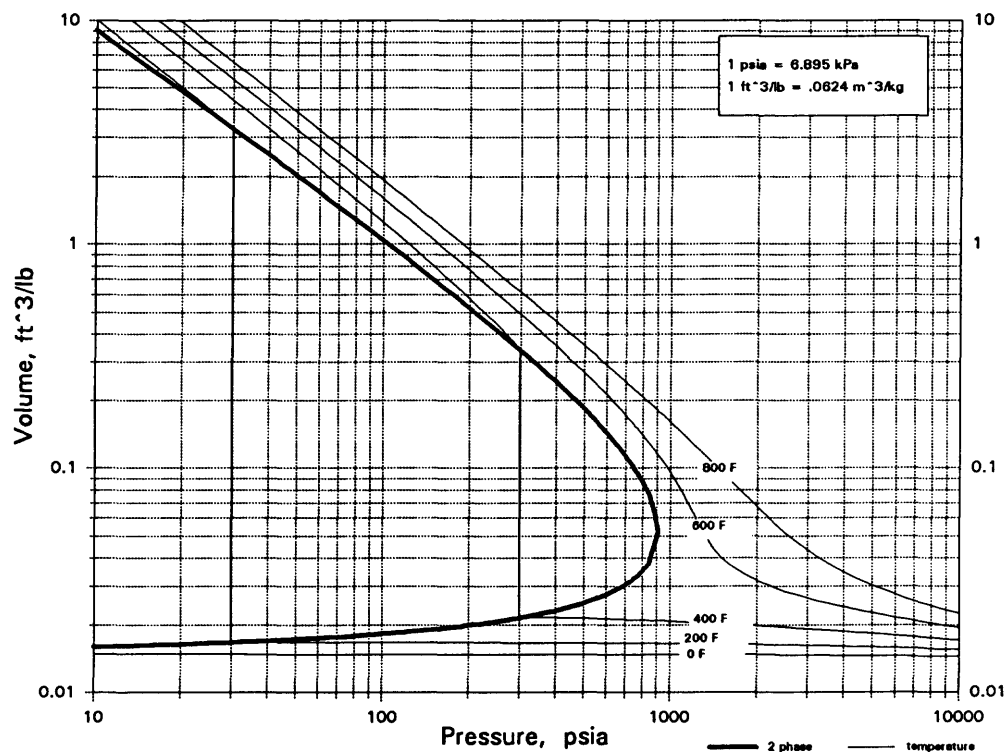
C3H3N

ACRYLONITRILE



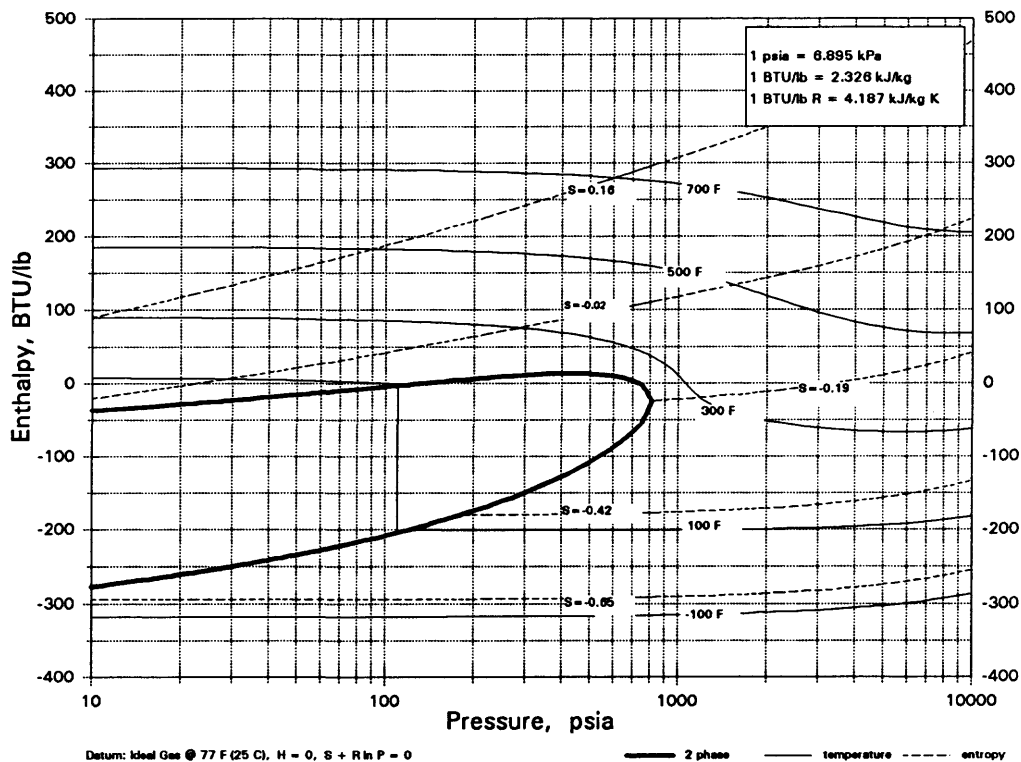
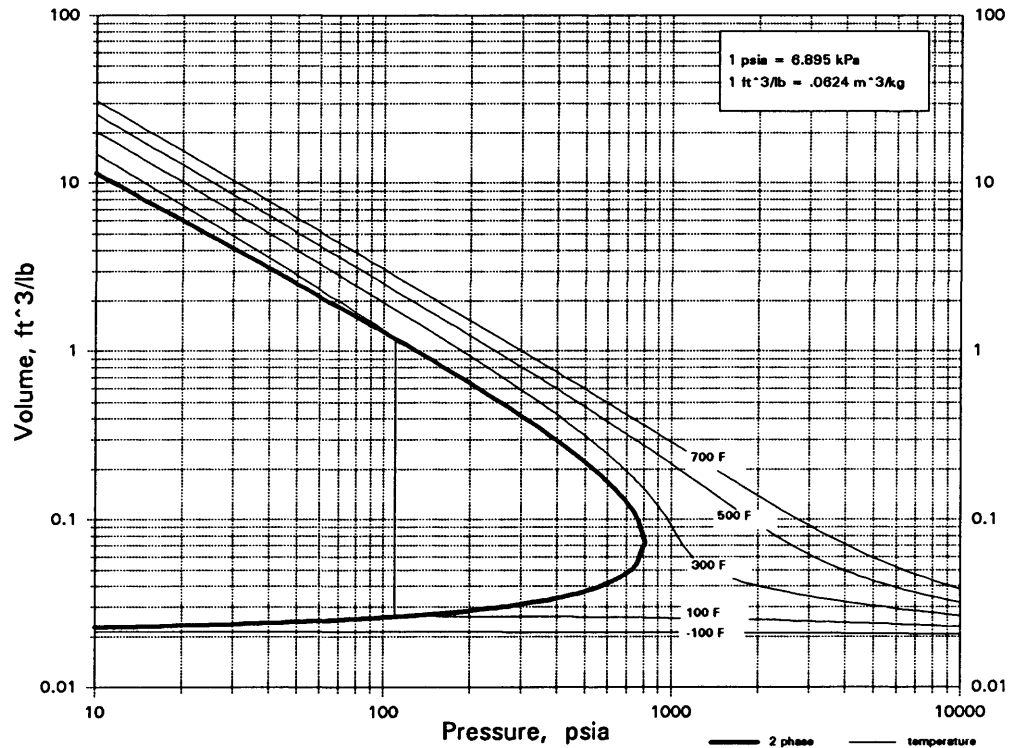
C3H3NO

OXAZOLE

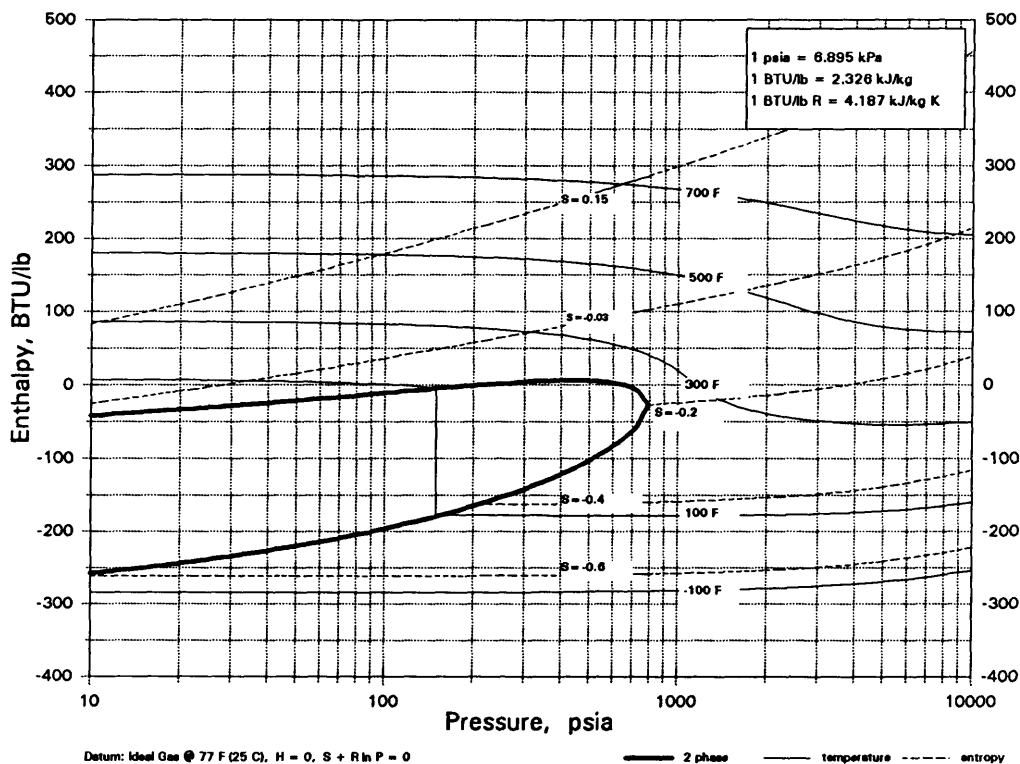
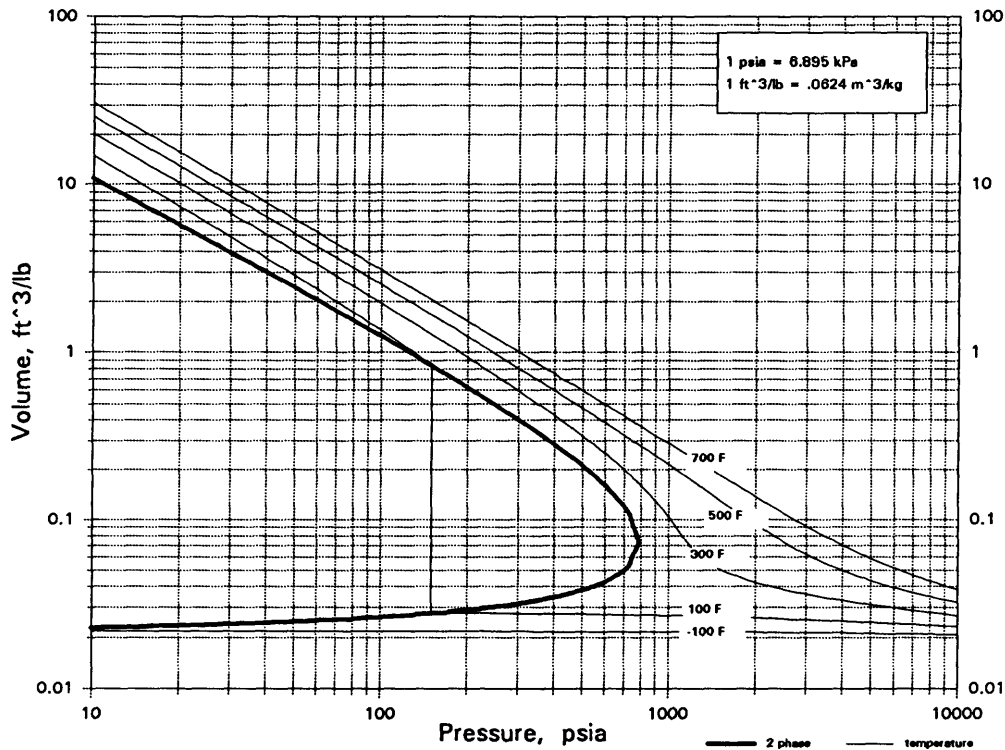


C3H4

METHYLACETYLENE

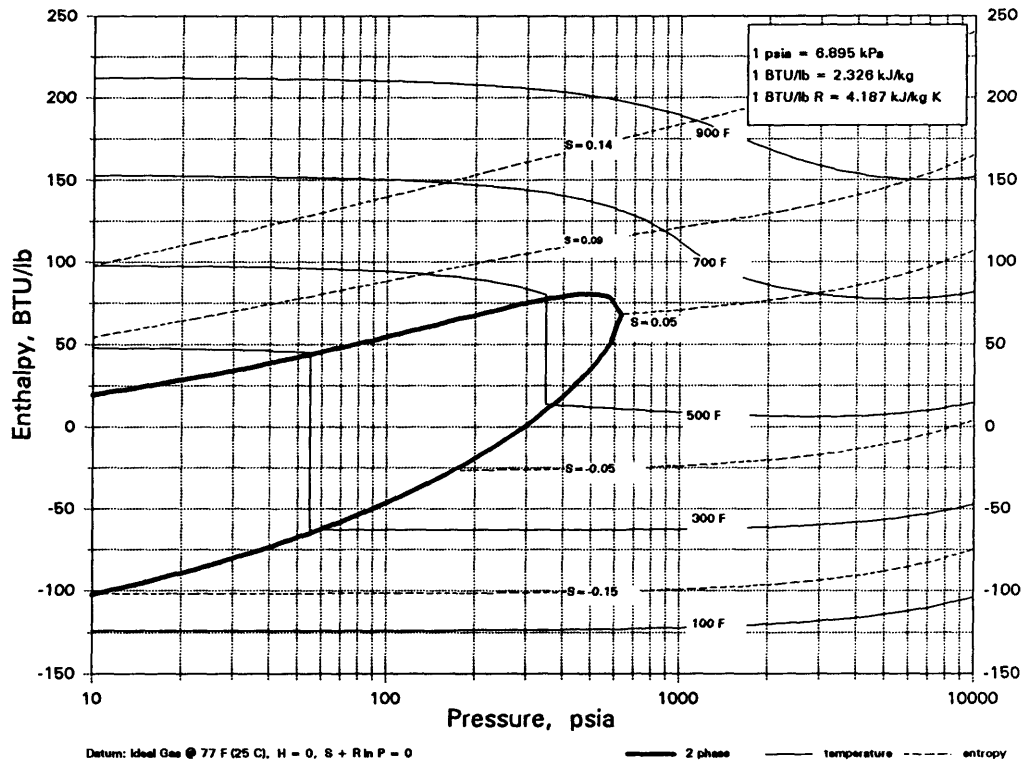
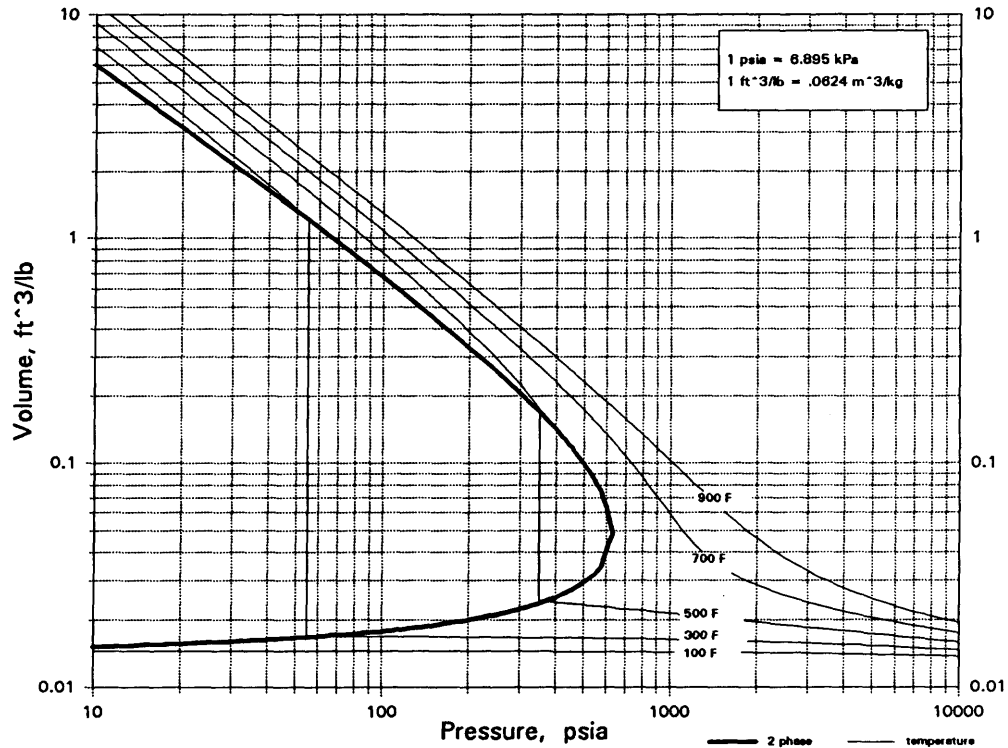


C3H4
PROPADIENE



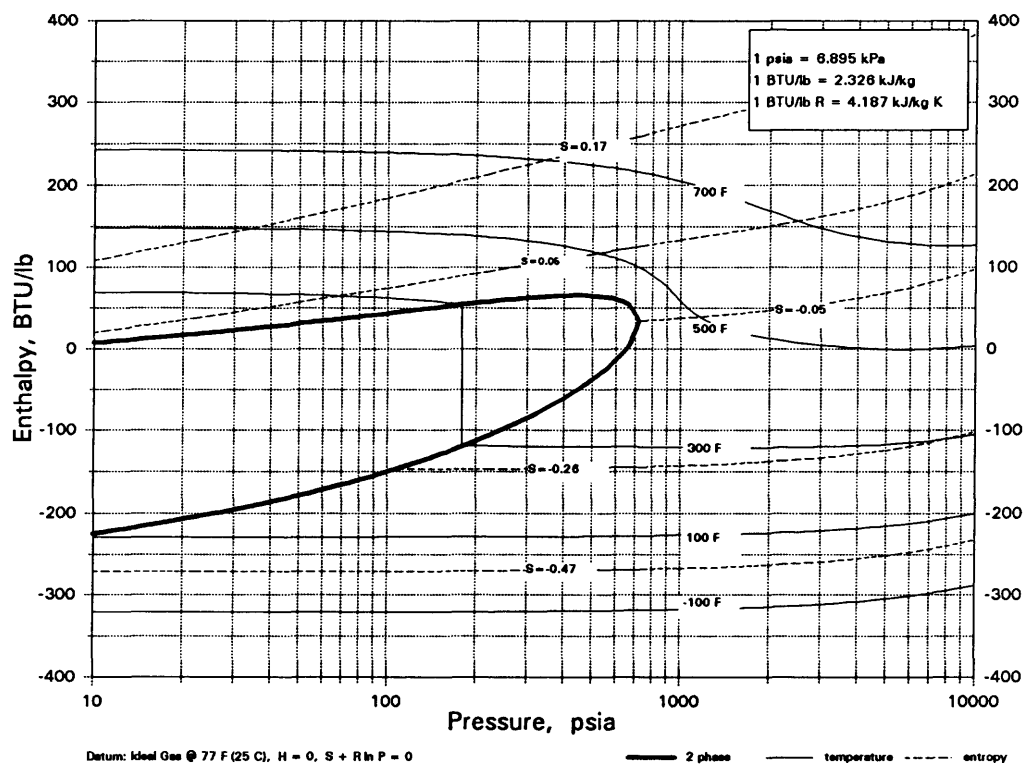
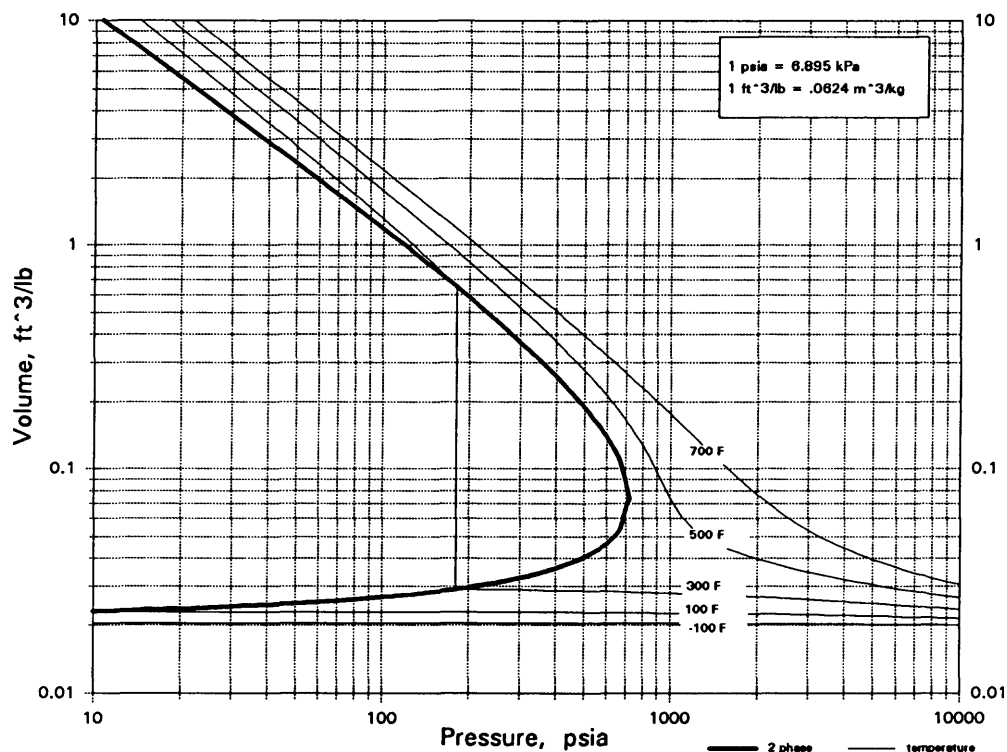
C3H4Cl2

2-3-DICHLOROPROPENE



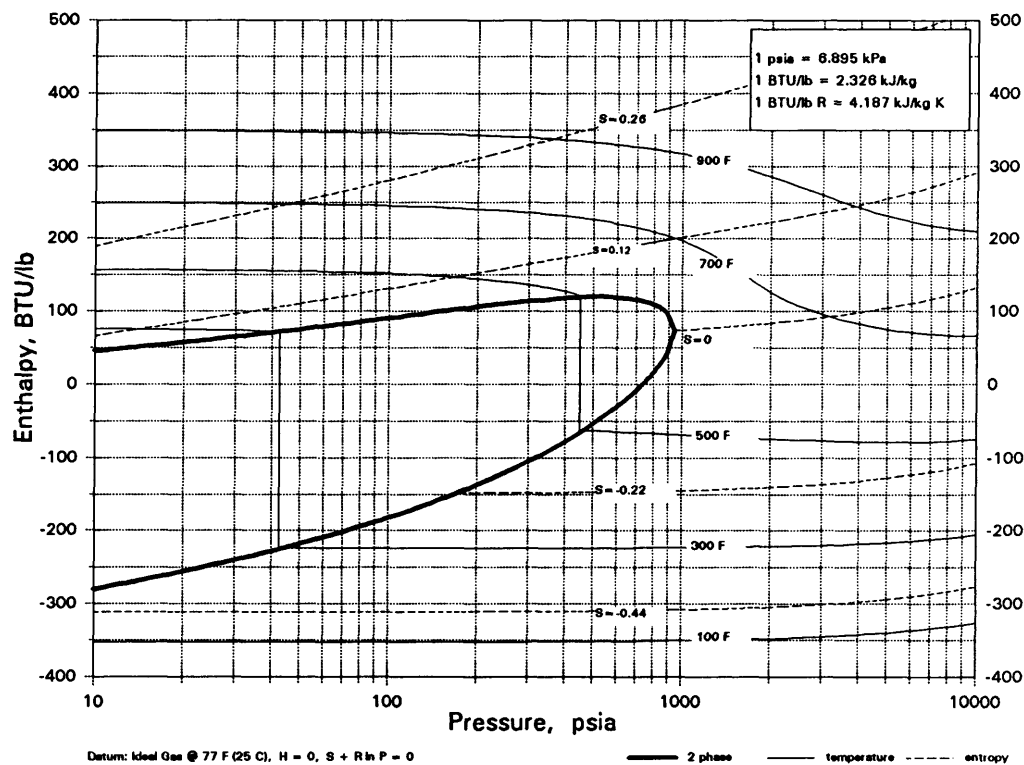
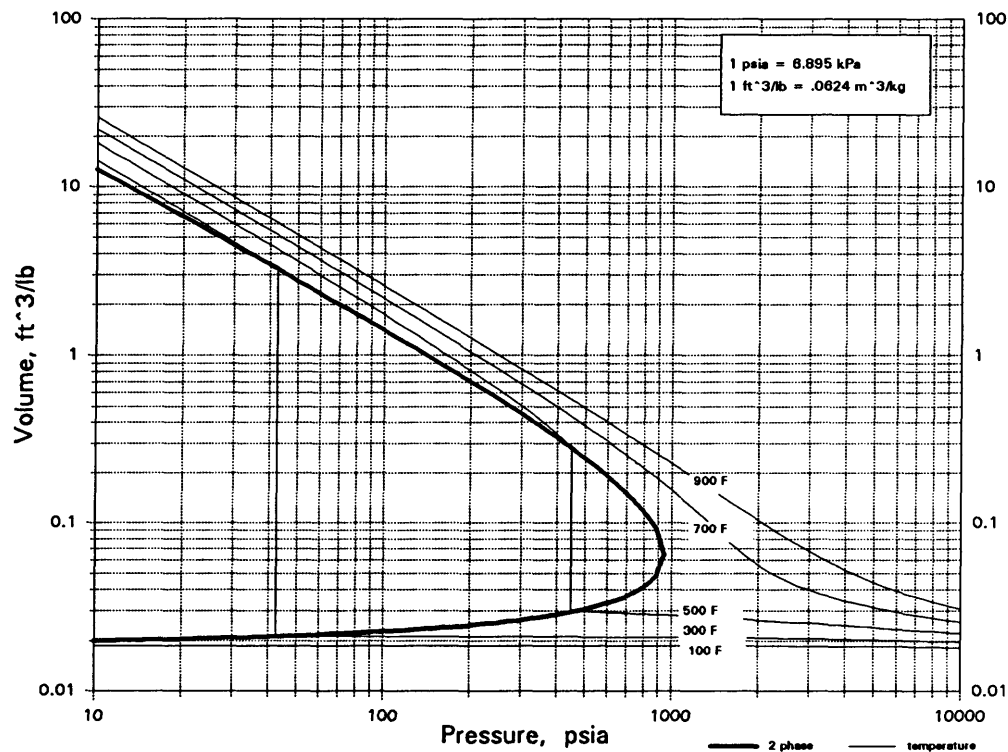
C3H4O

ACROLEIN

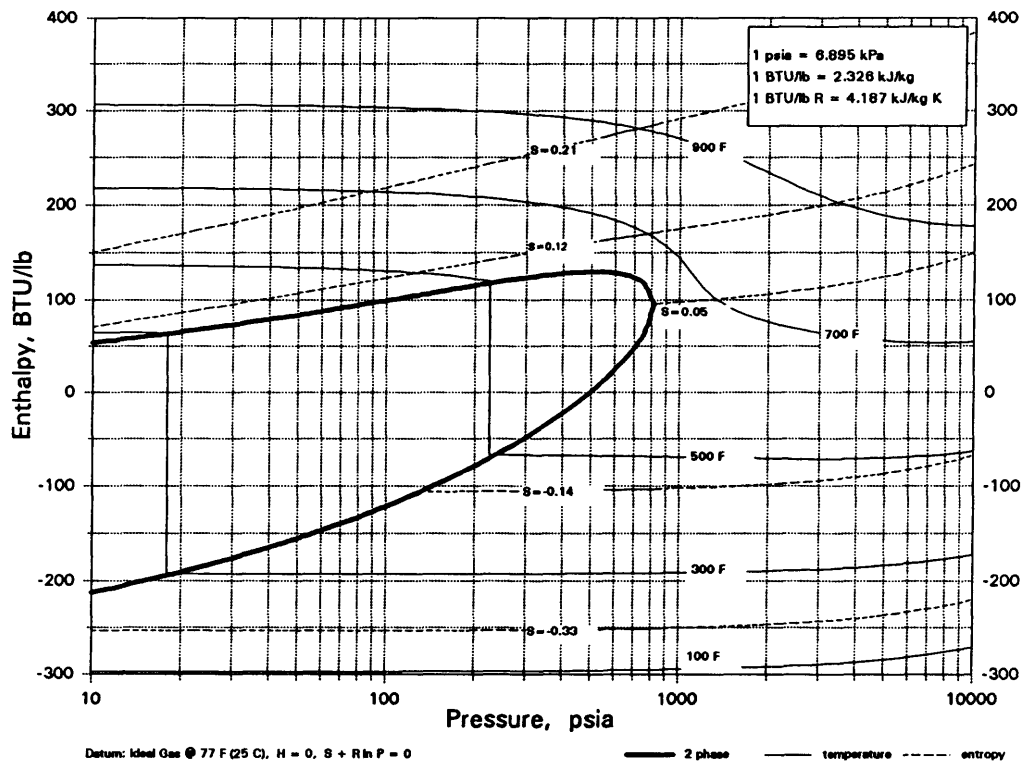
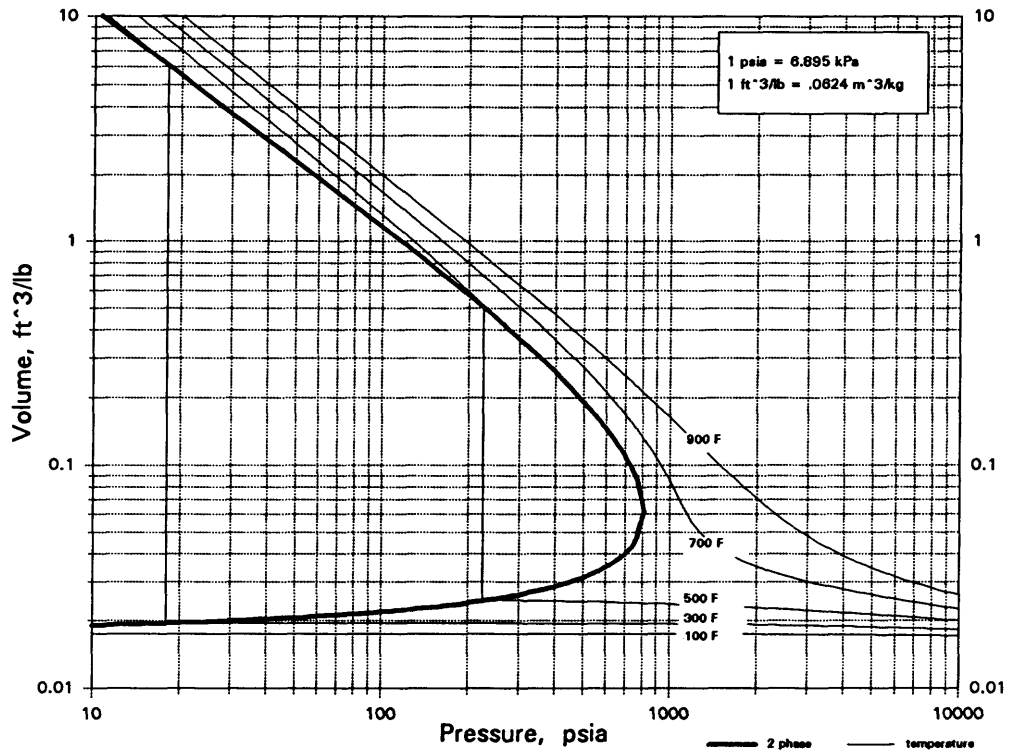


C3H4O

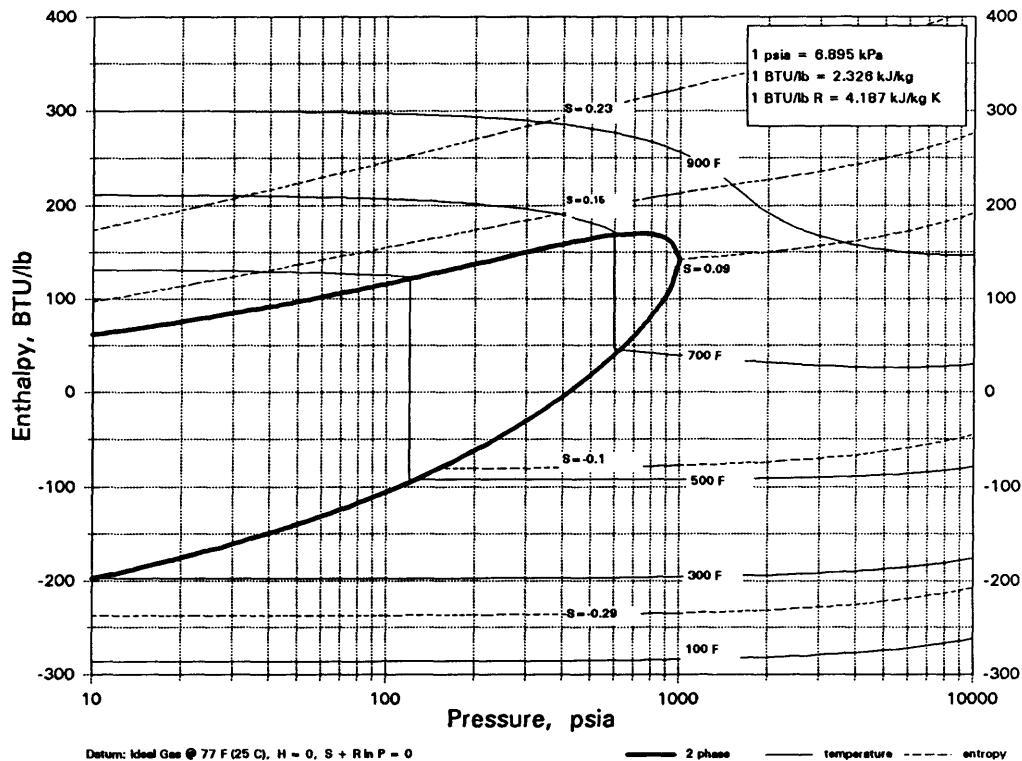
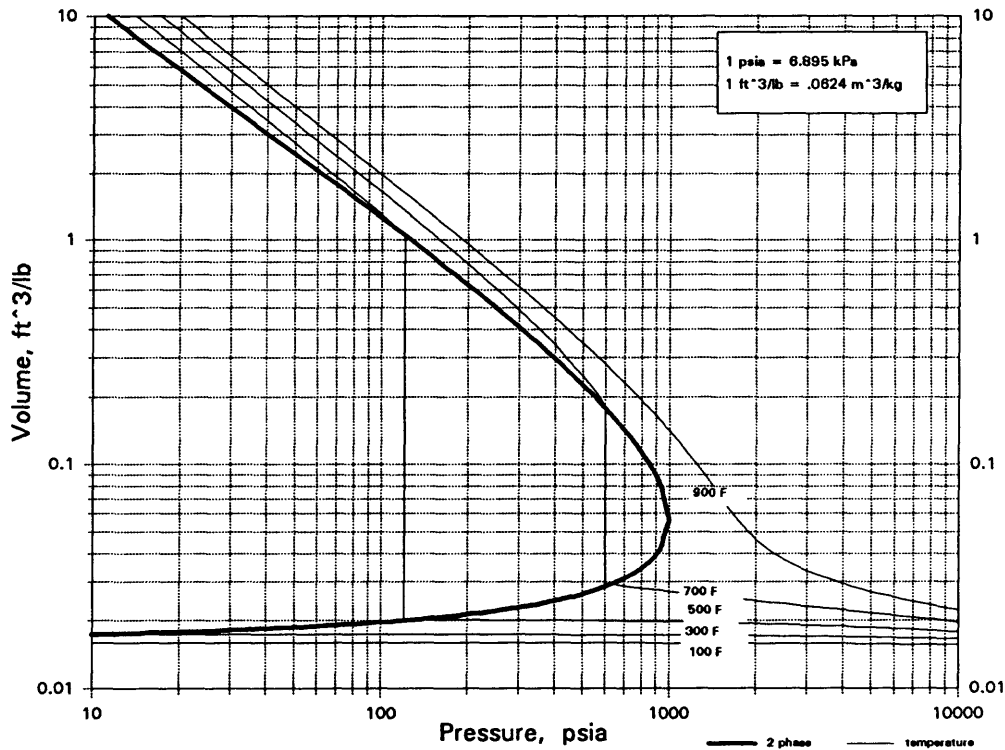
PROPARGYL ALCOHOL



C3H4O2
ACRYLIC ACID

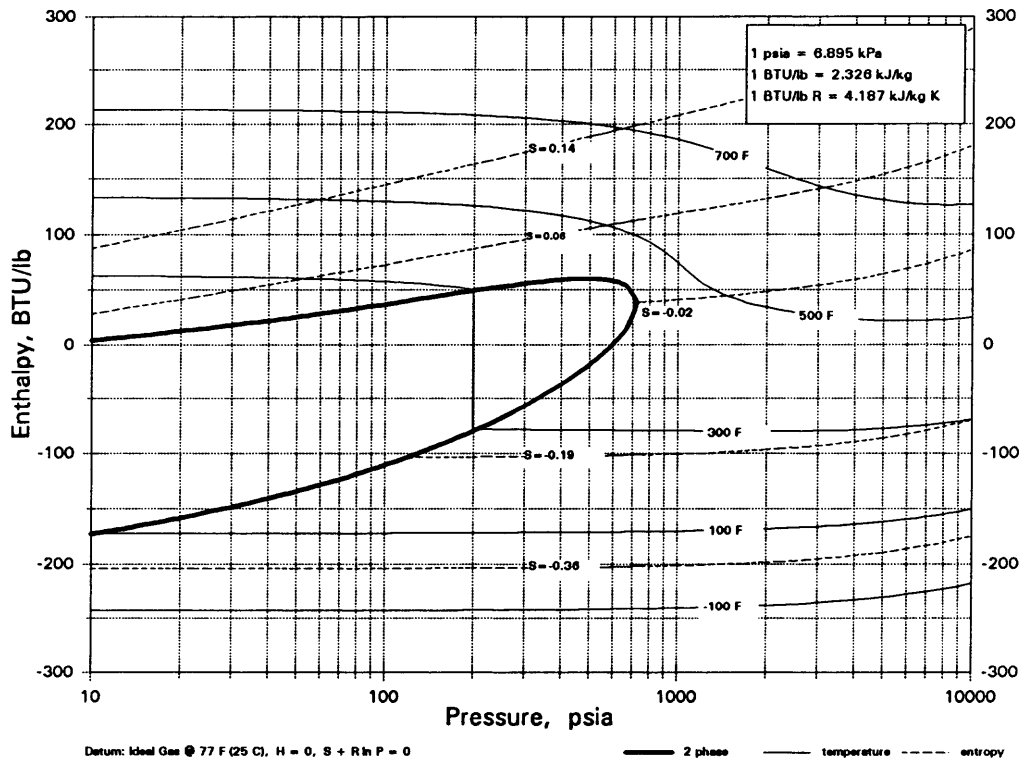
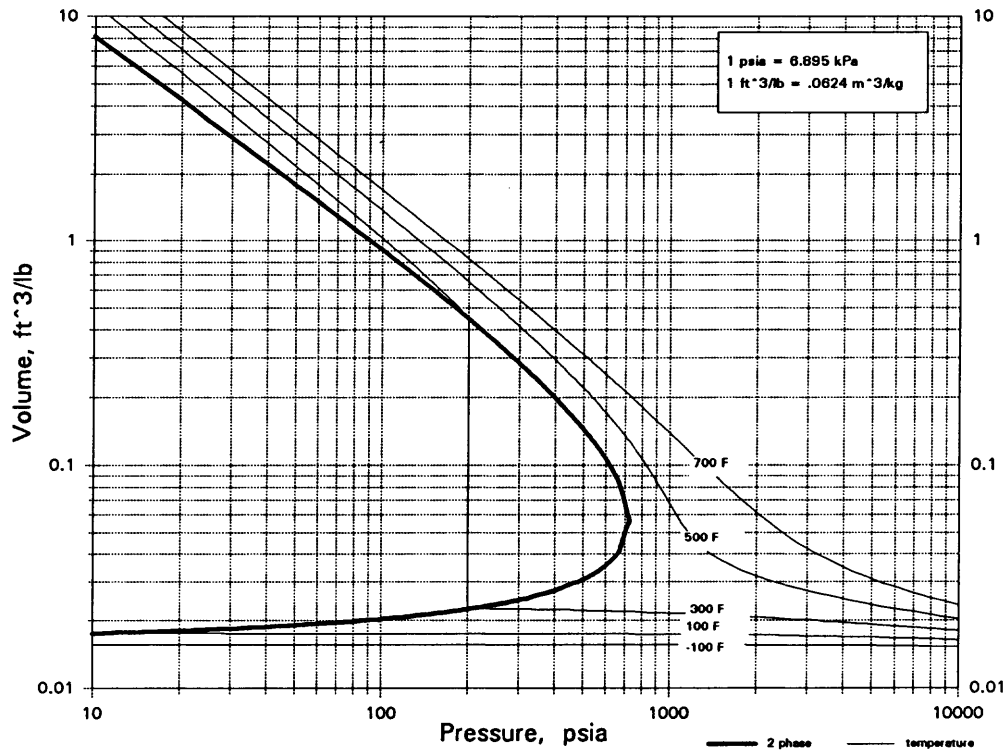


C3H4O2
beta-PROPIOLACTONE



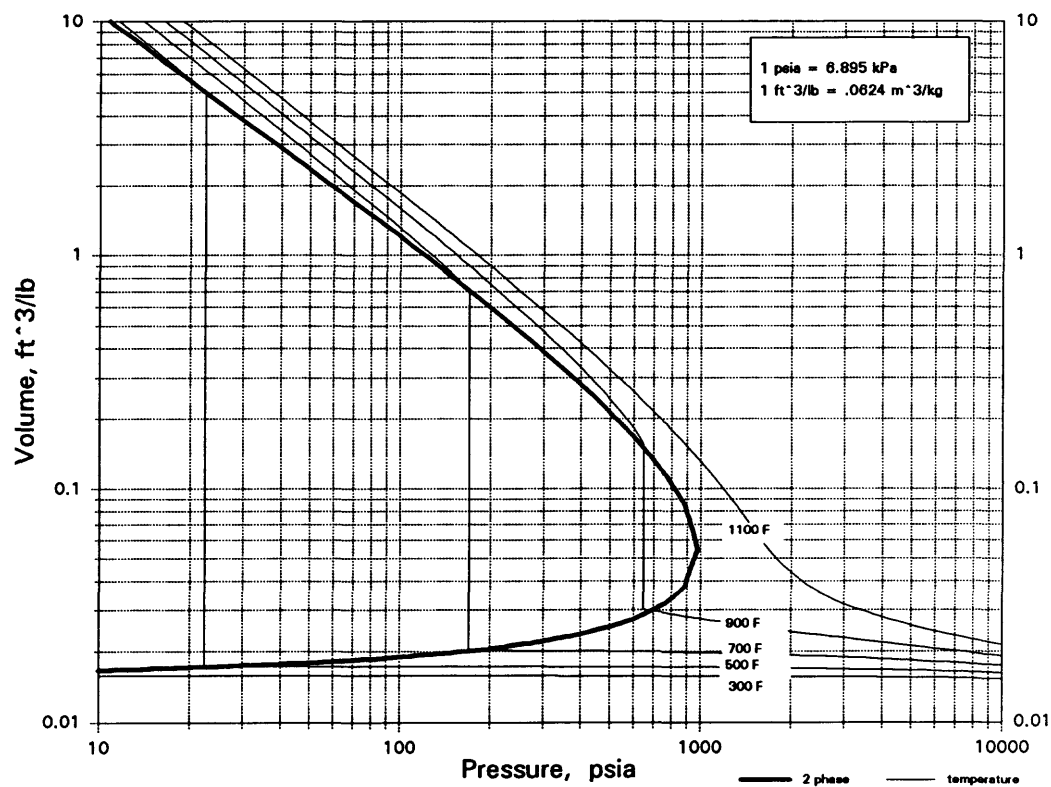
C3H4O2

VINYL FORMATE



C3H4O3

ETHYLENE CARBONATE

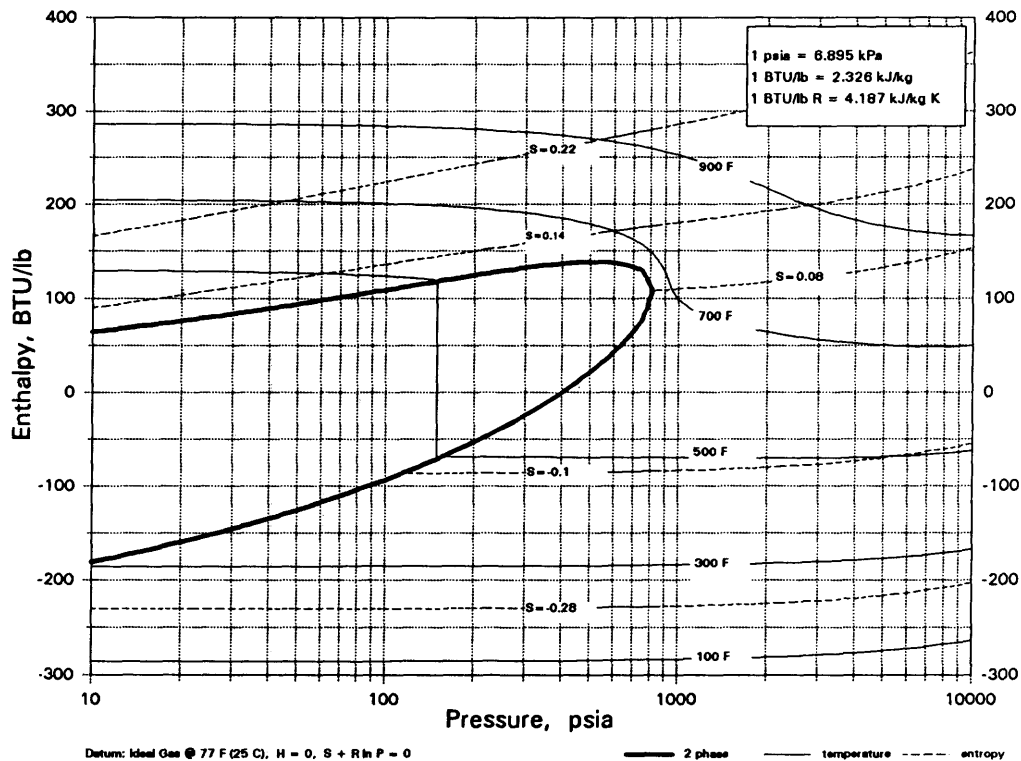
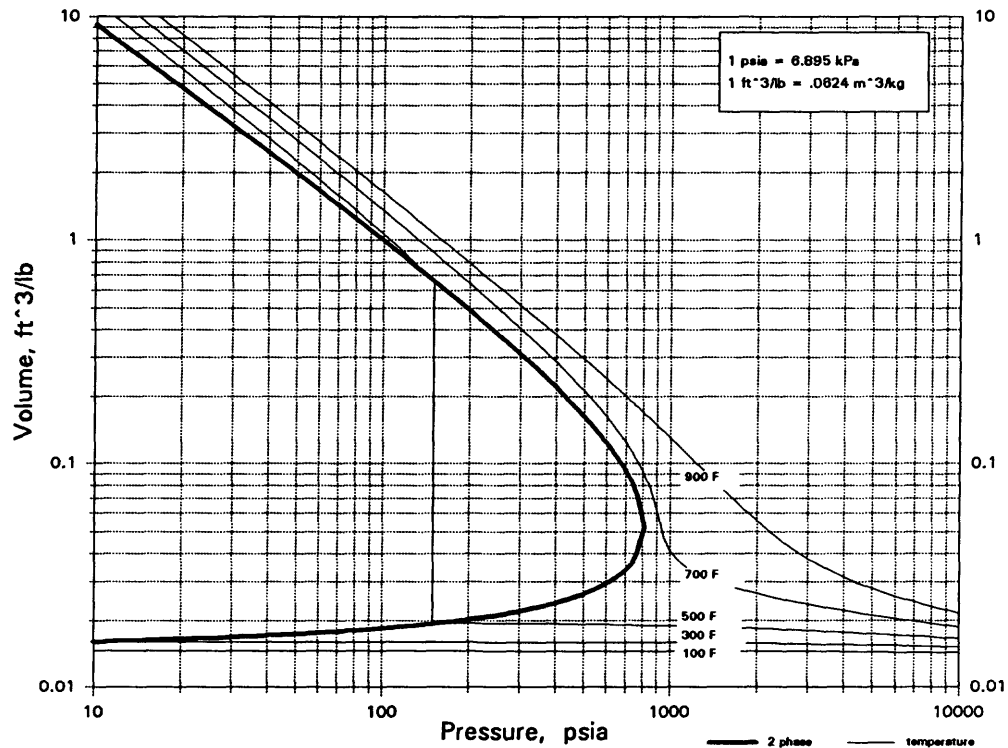


1. Boiling Point, K..... 511.15
2. Critical Temperature, K.... 790.00
3. Critical Pressure, atm..... 66.81

Heat capacity data are not available.

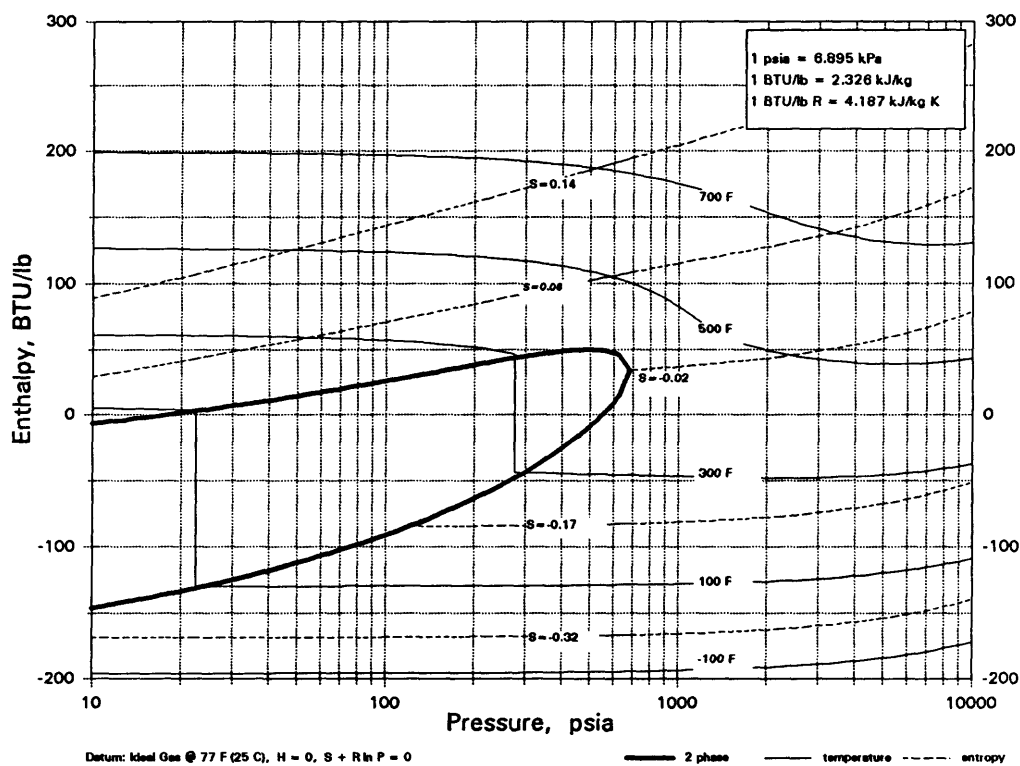
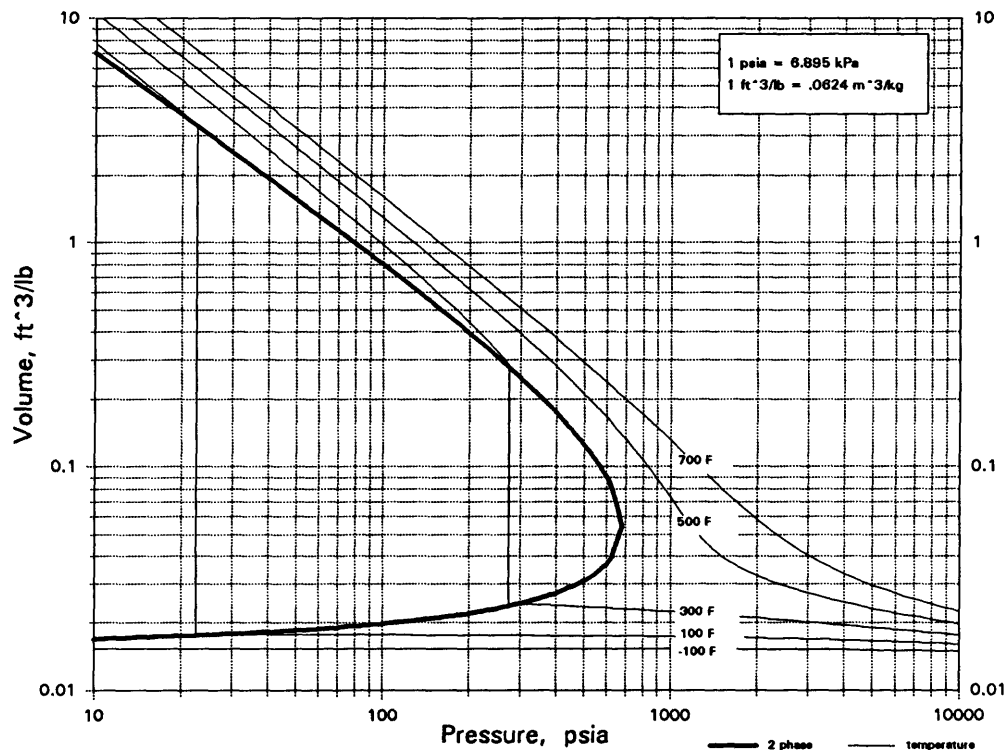
C3H4O3

PYRUVIC ACID



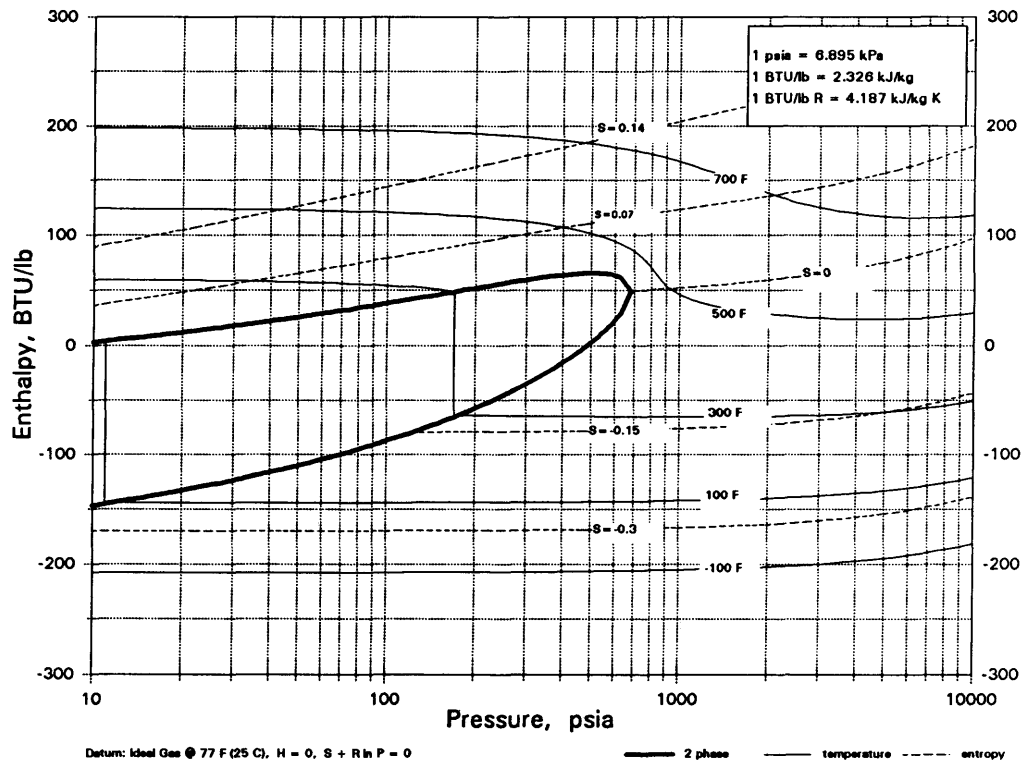
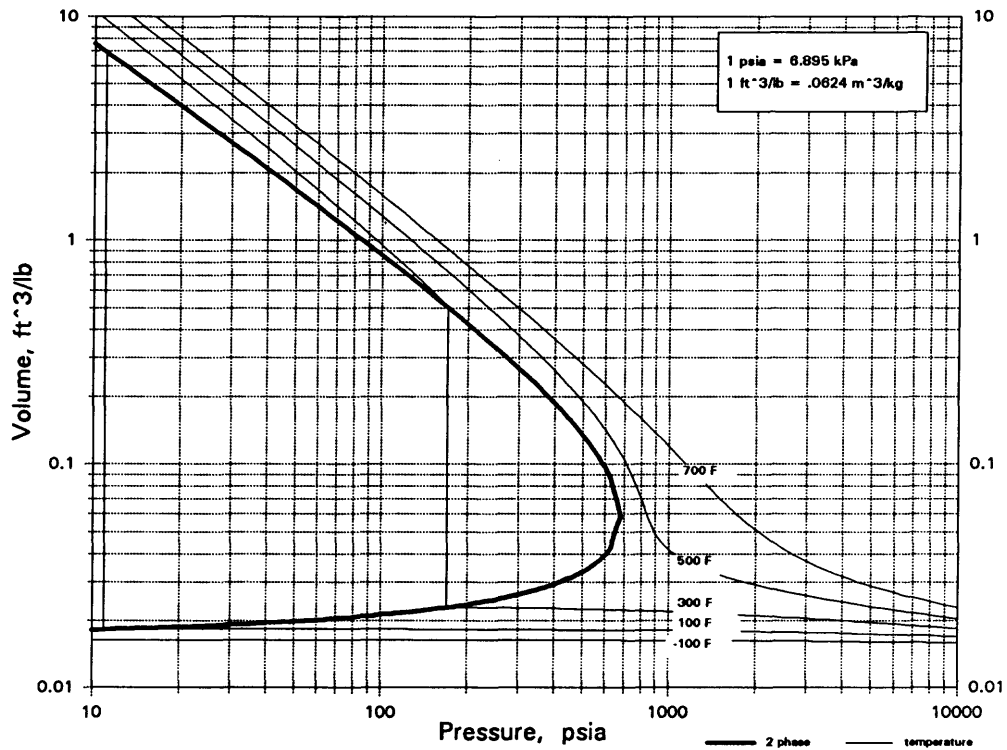
C3H5Cl

2-CHLOROPROPENE



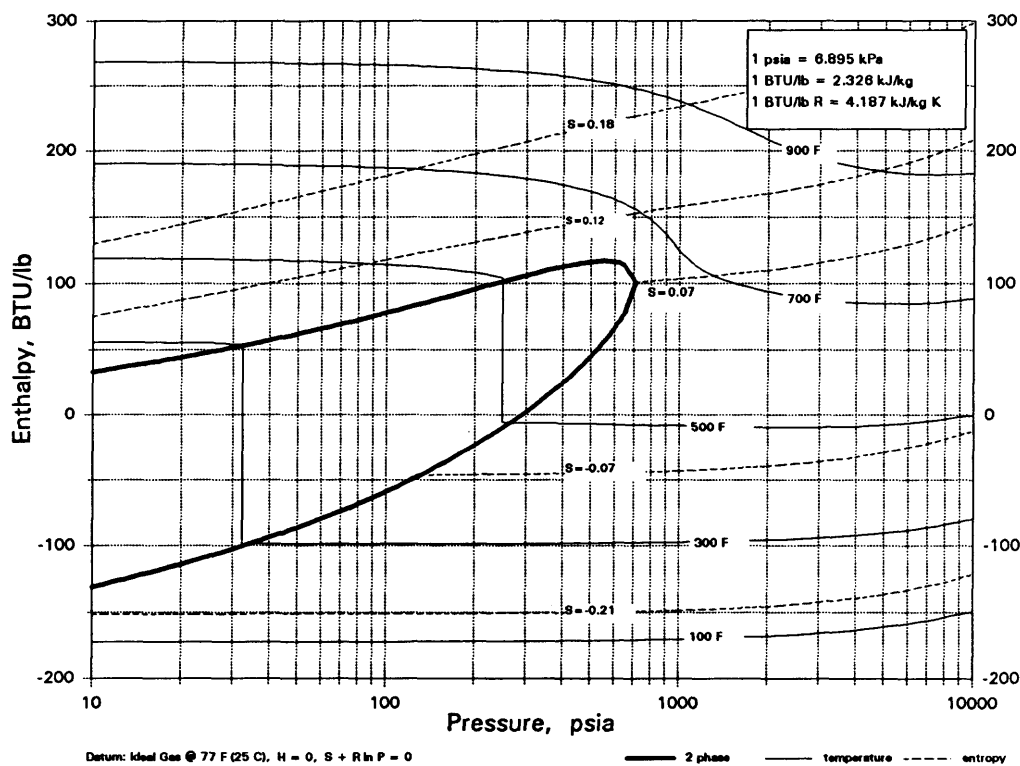
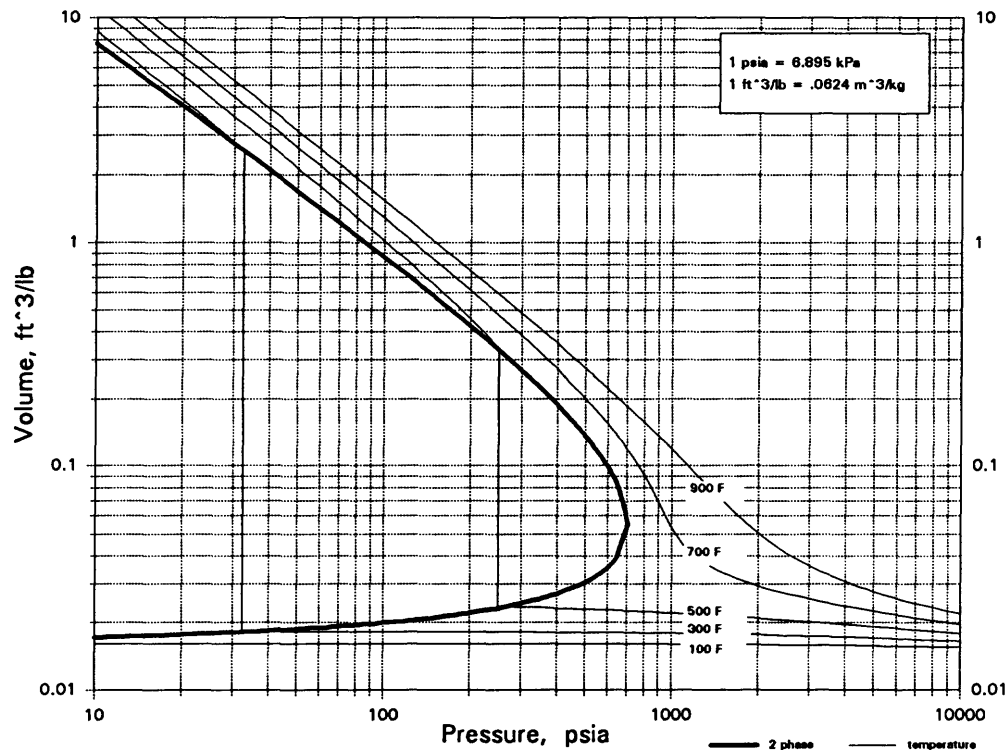
C3H5Cl

3-CHLOROPROPENE



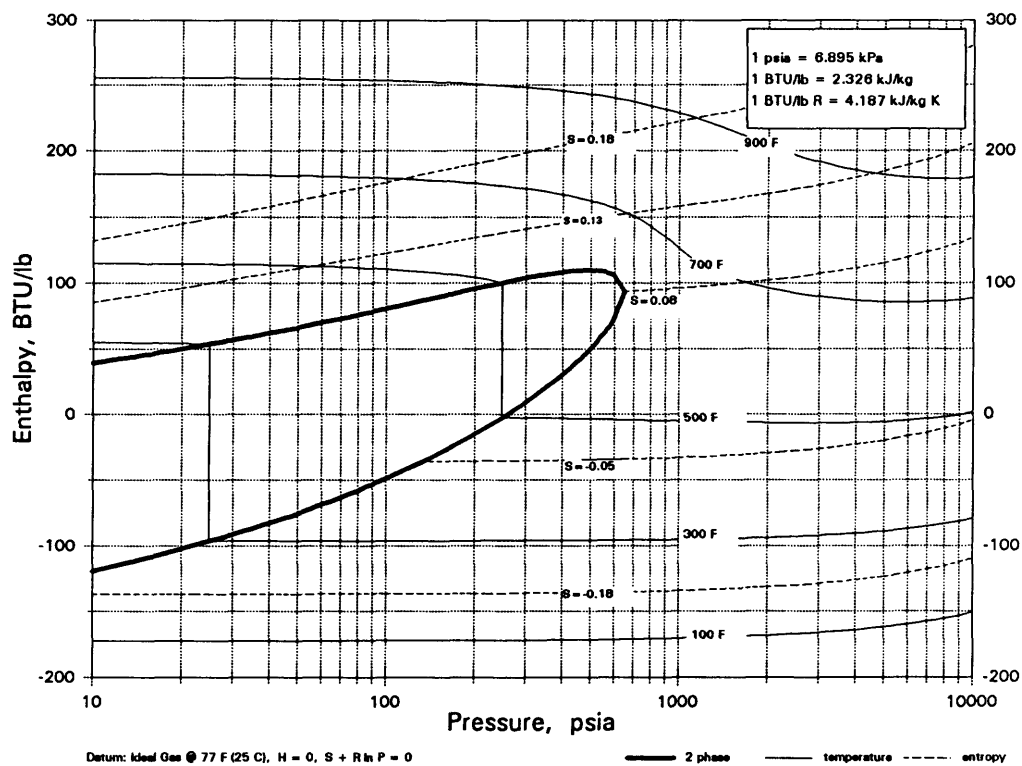
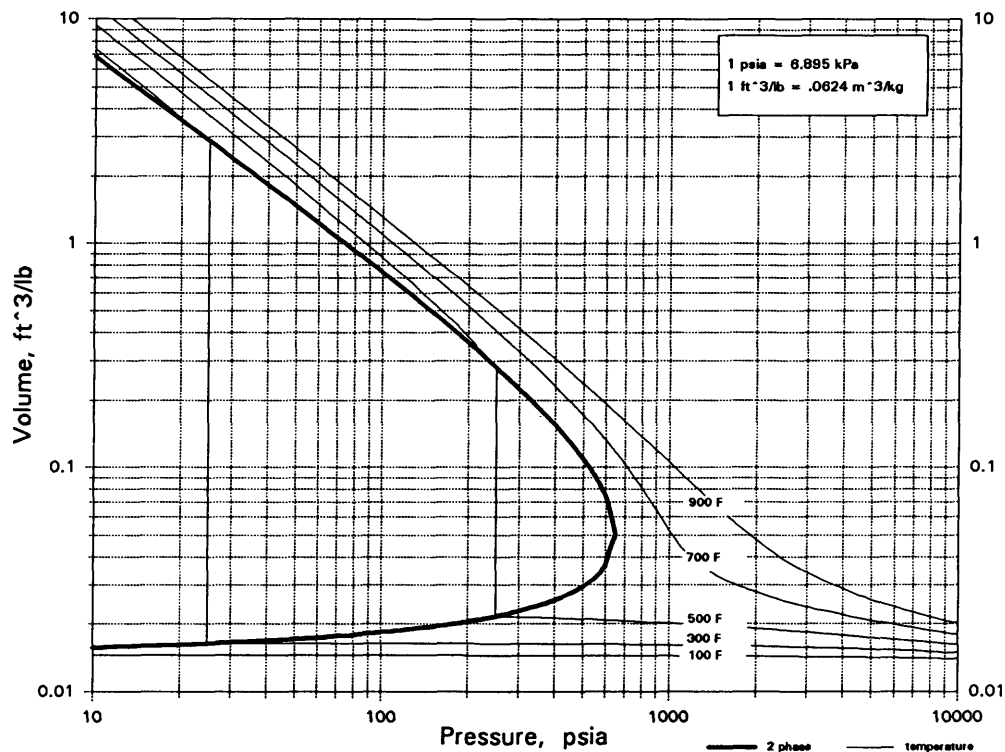
C3H5ClO

alpha-EPOCHLOROHYDRIN



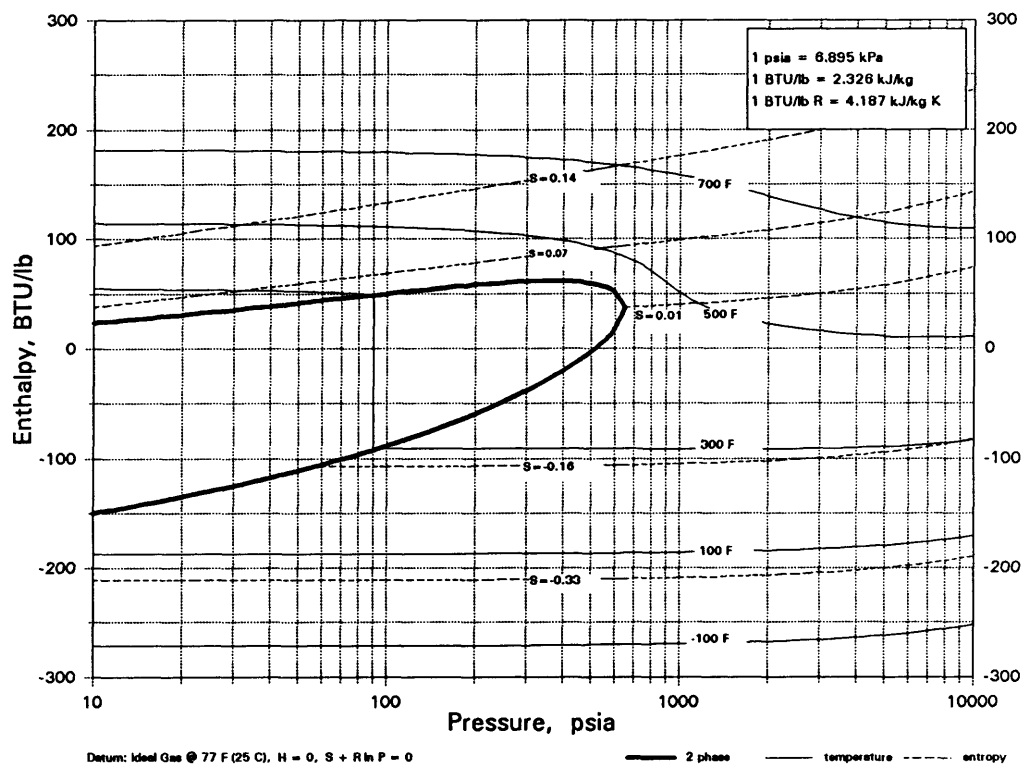
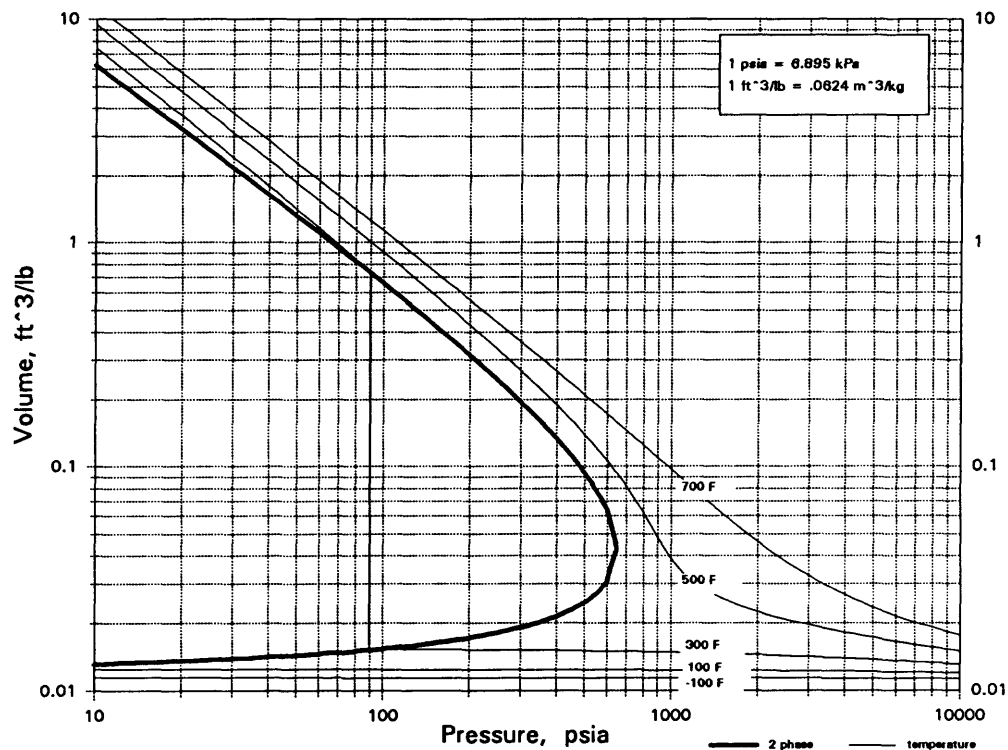
C3H5ClO2

METHYL CHLOROACETATE



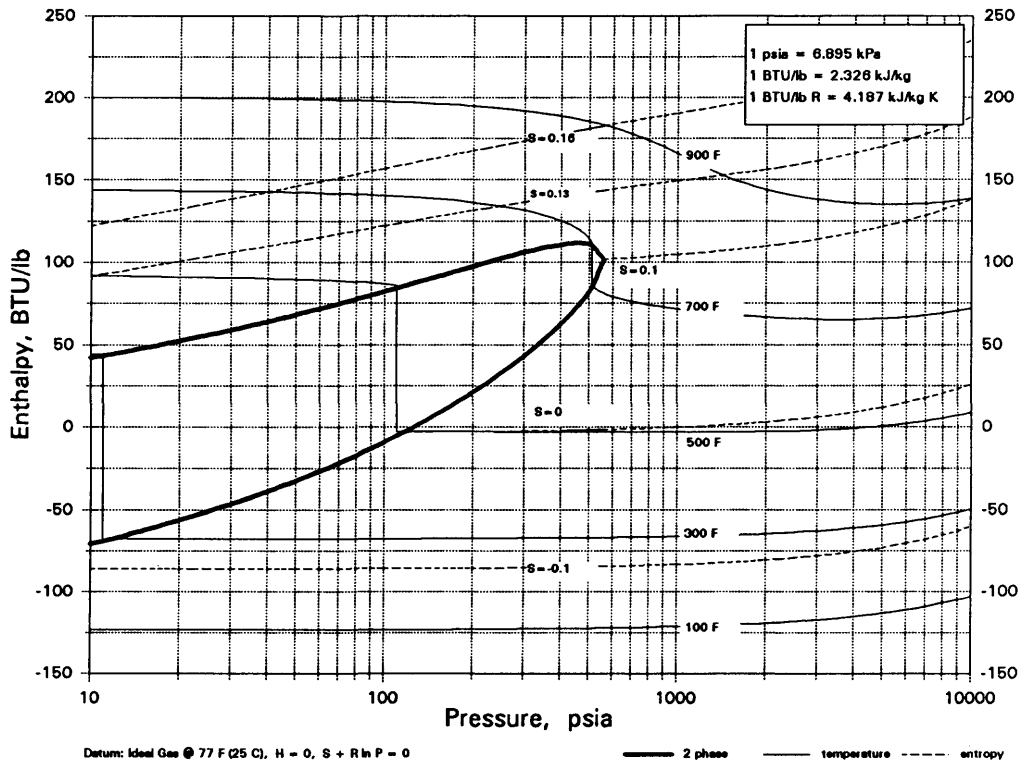
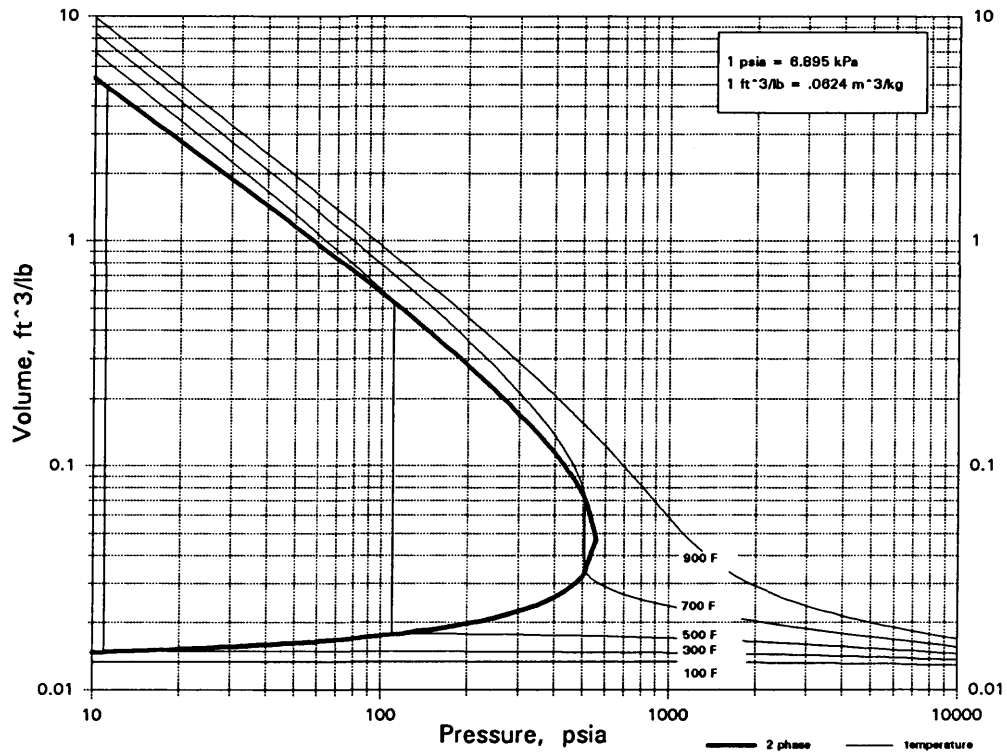
C3H5ClO2

ETHYL CHLOROFORMATE

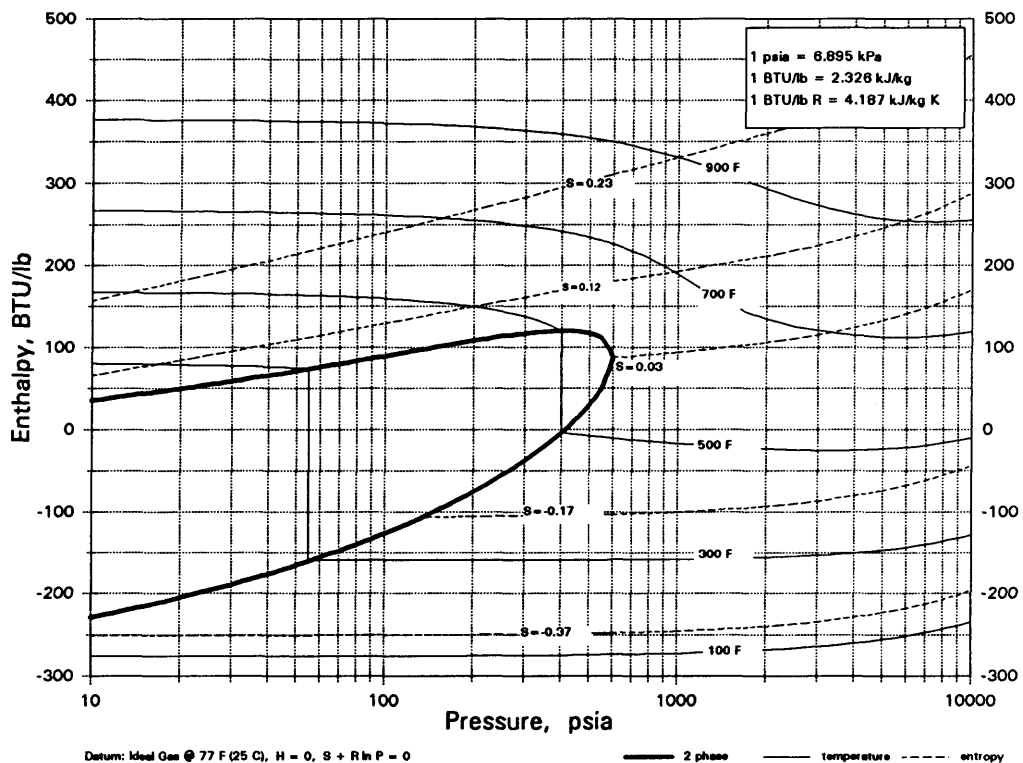
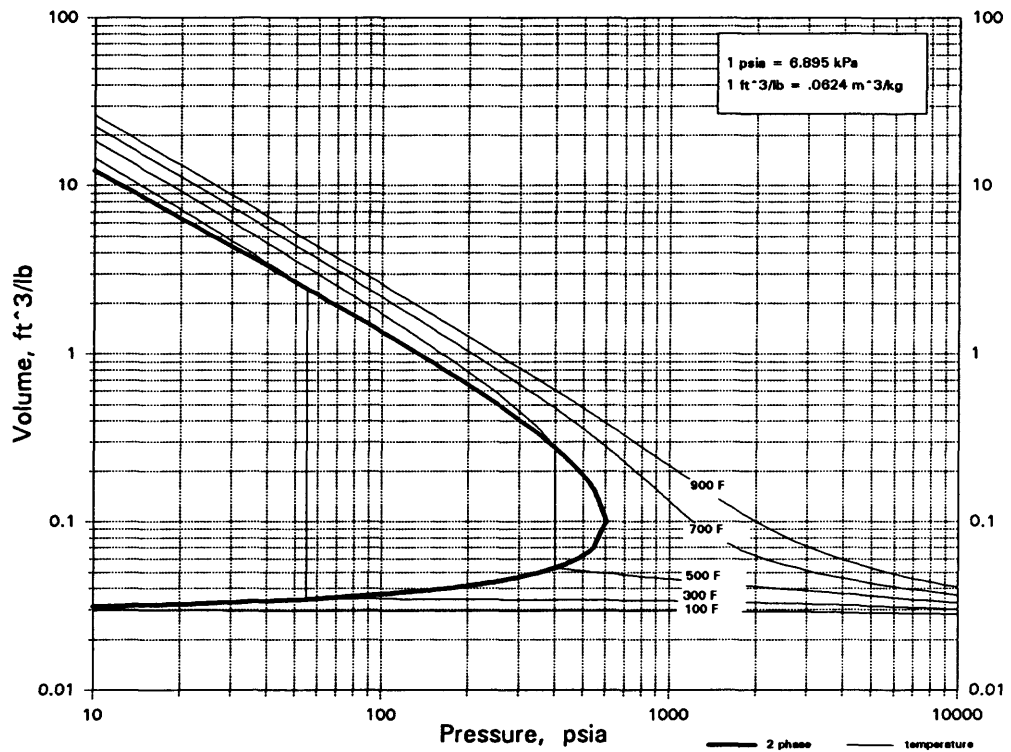


C3H5Cl3

1-2-3-TRICHLOROPROPANE

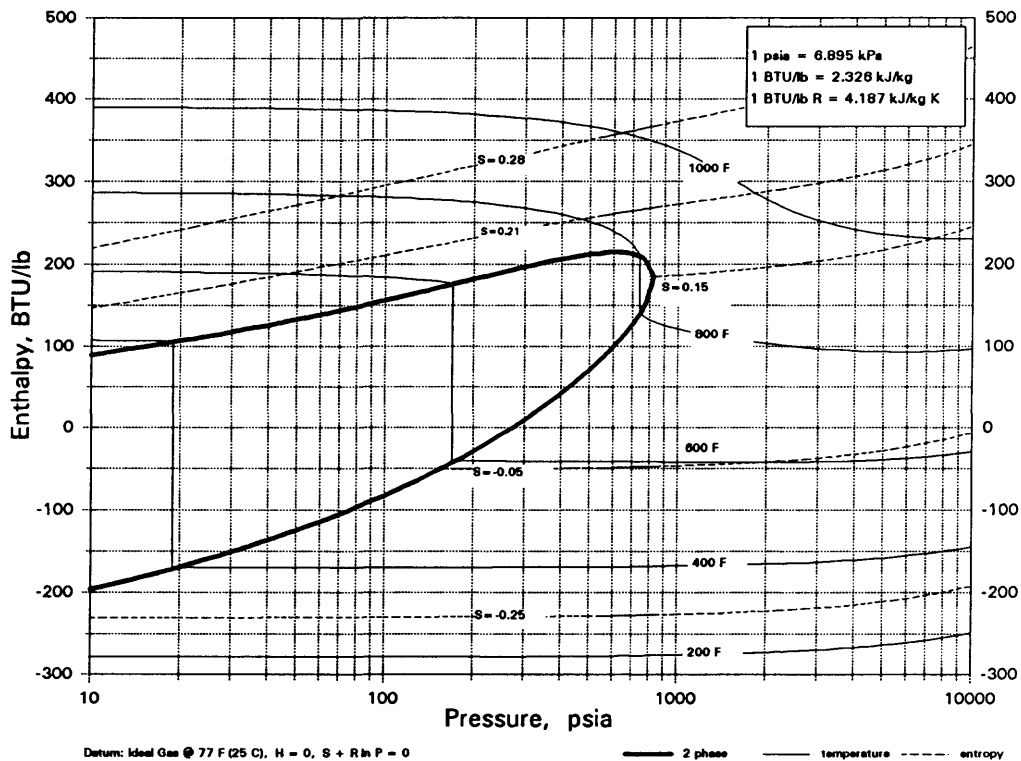
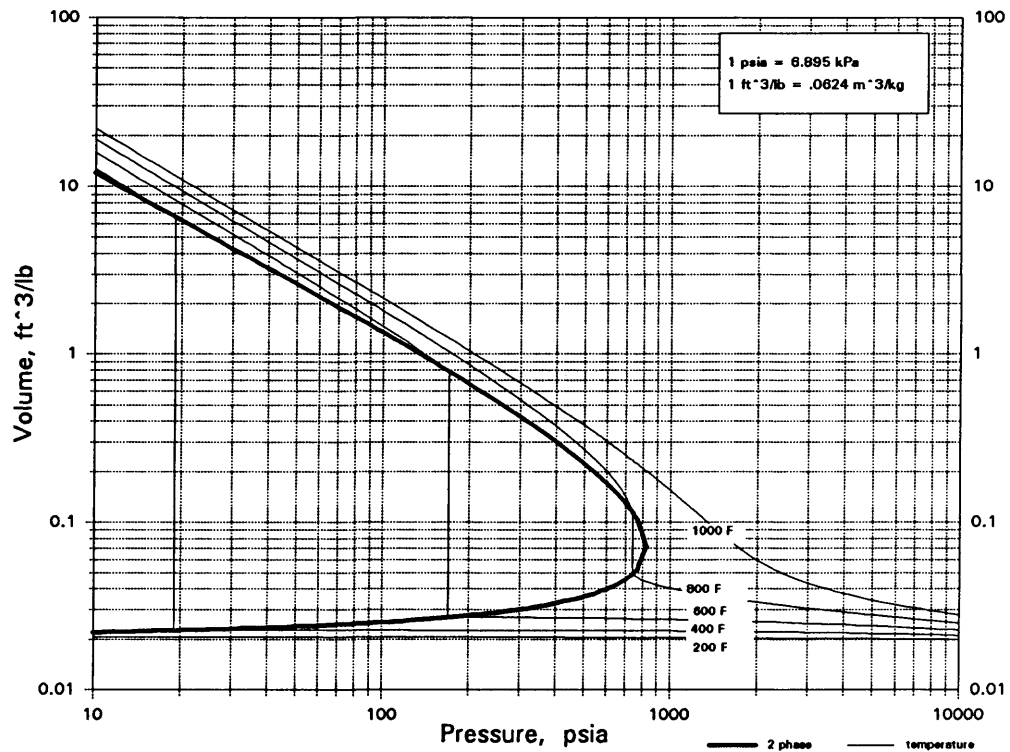


C3H5N
PROPIONITRILE

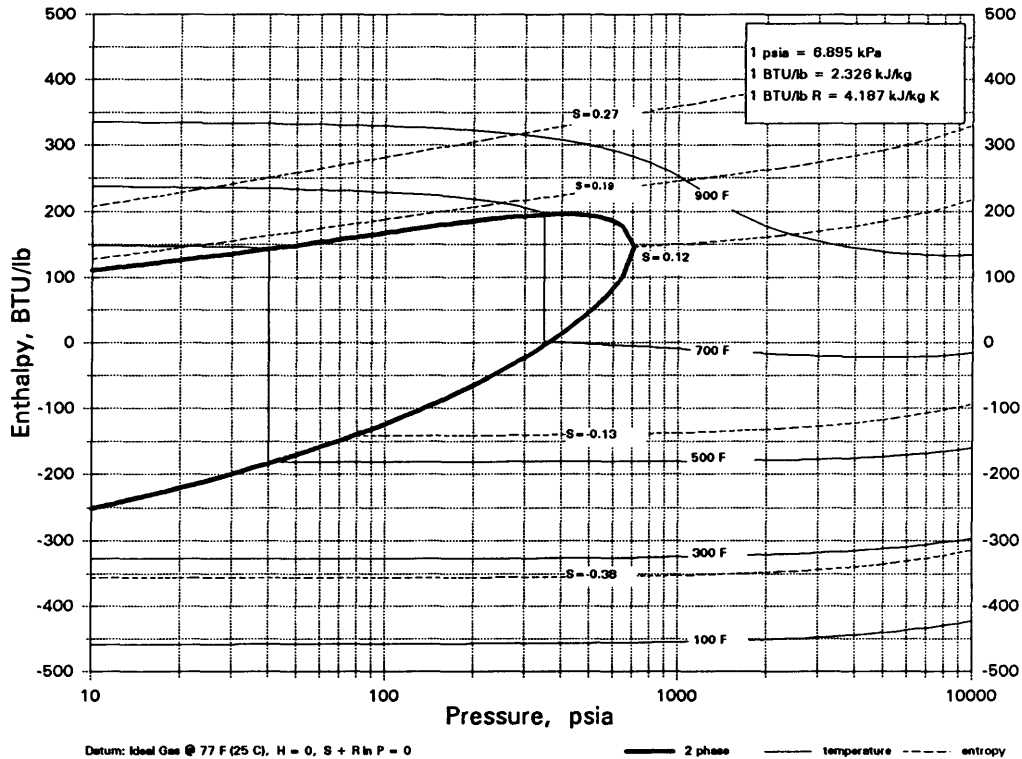
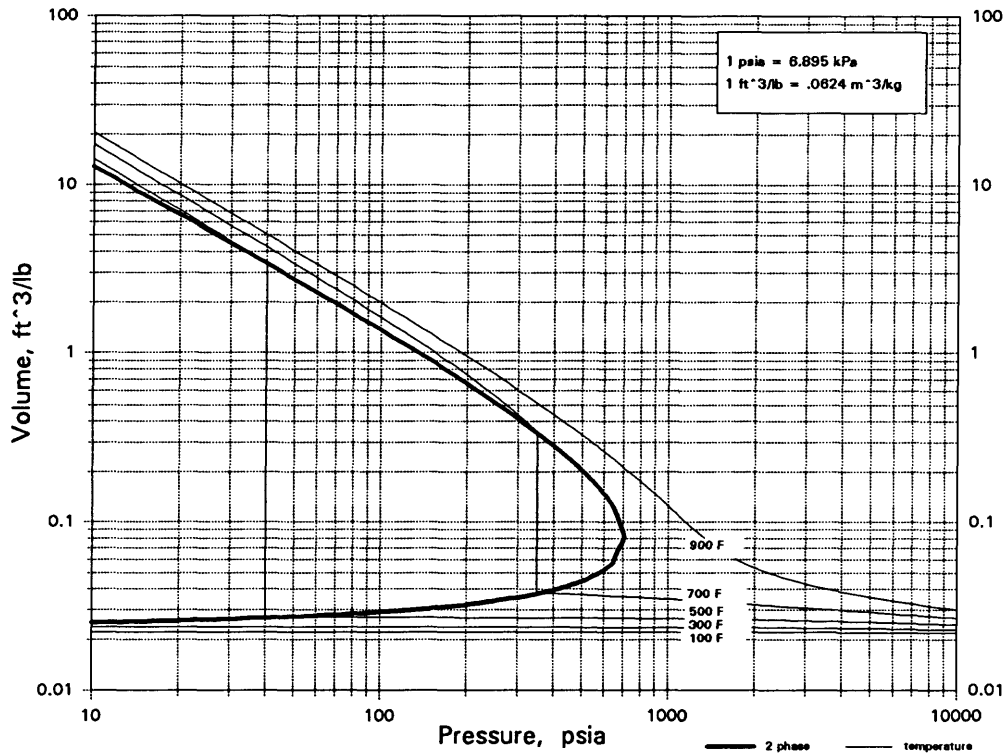


C3H5NO

ACRYLAMIDE

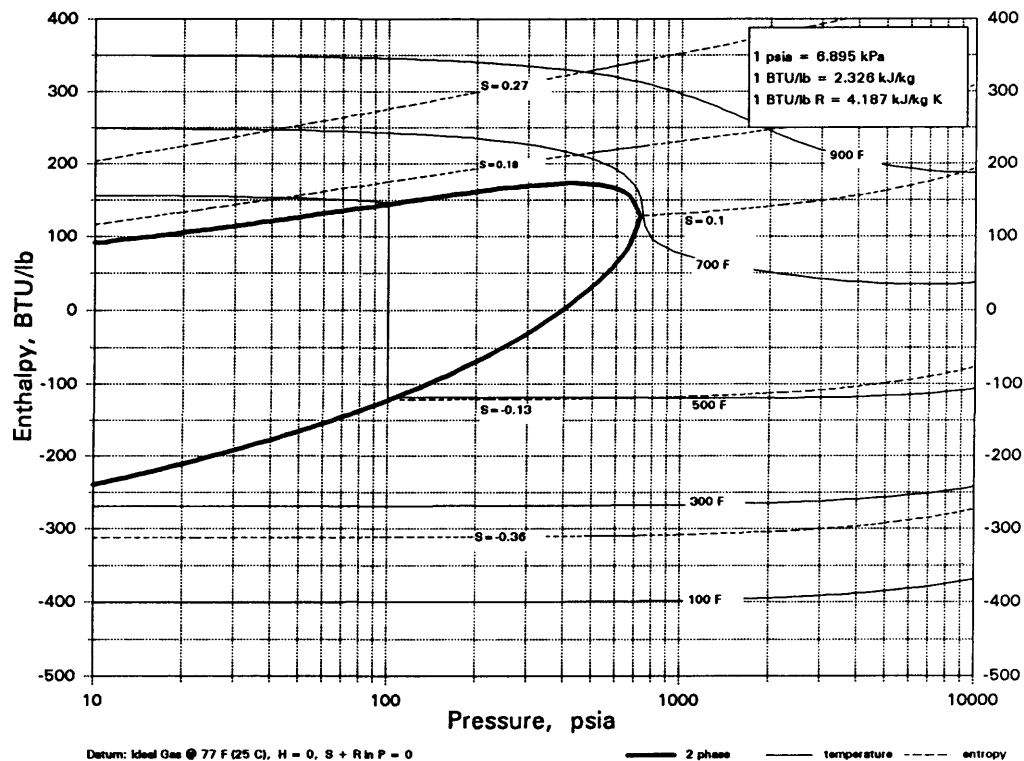
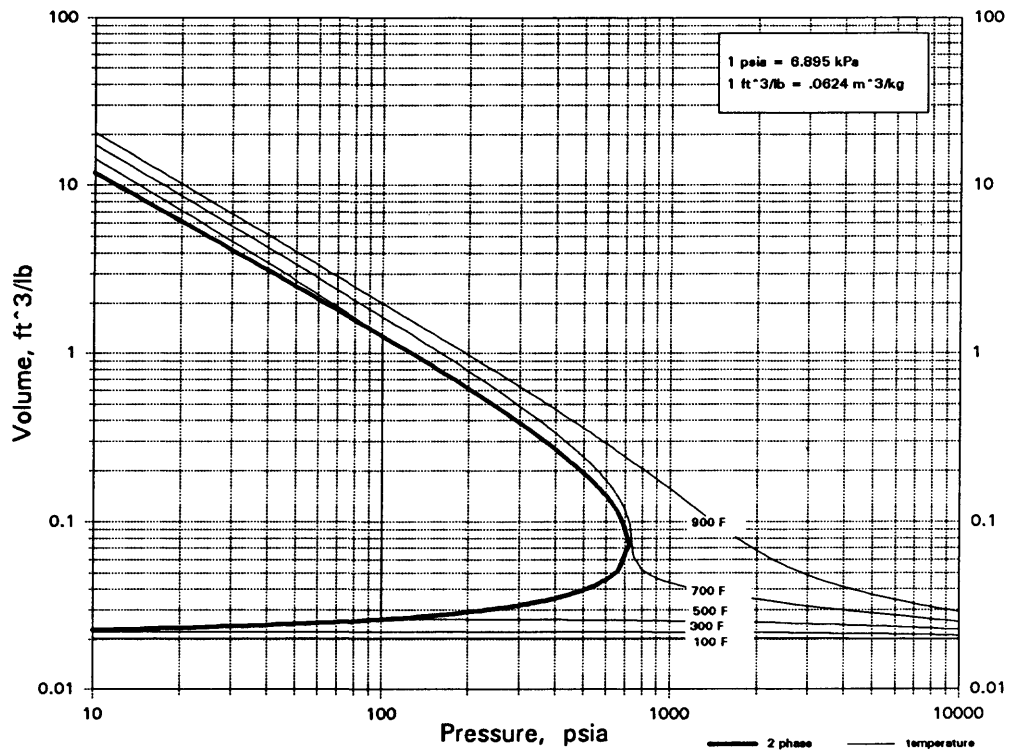


C3H5NO
HYDRACRYLONITRILE

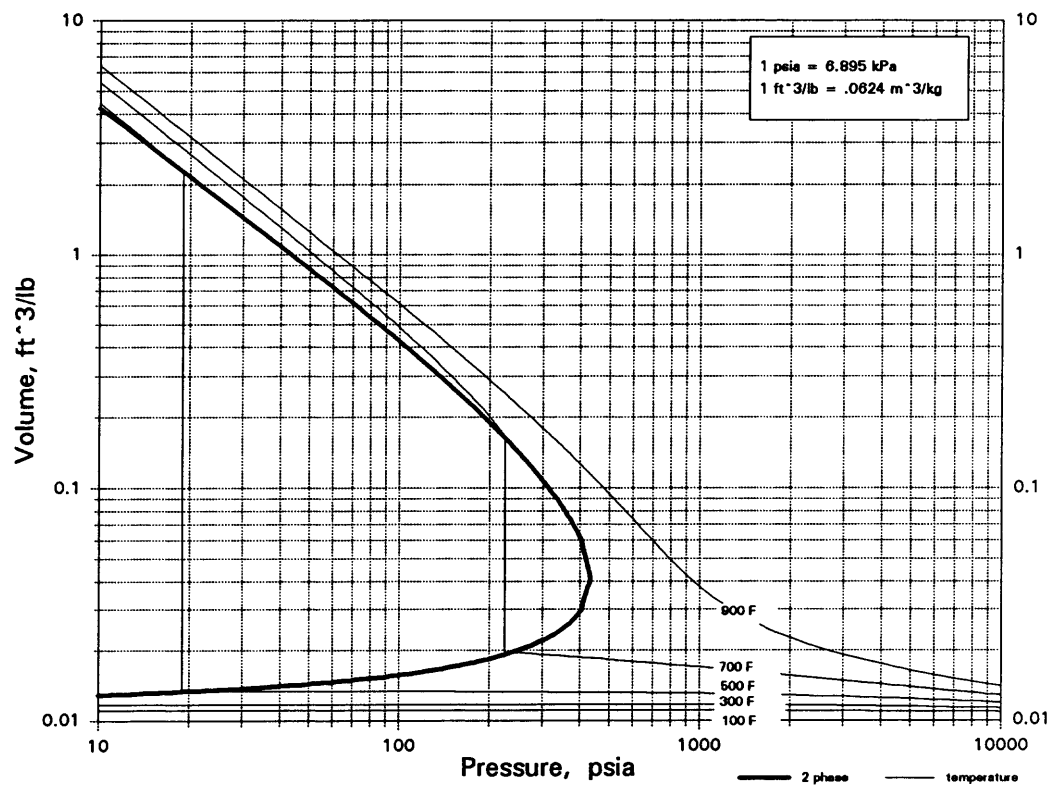


C3H5NO

LACTONITRILE



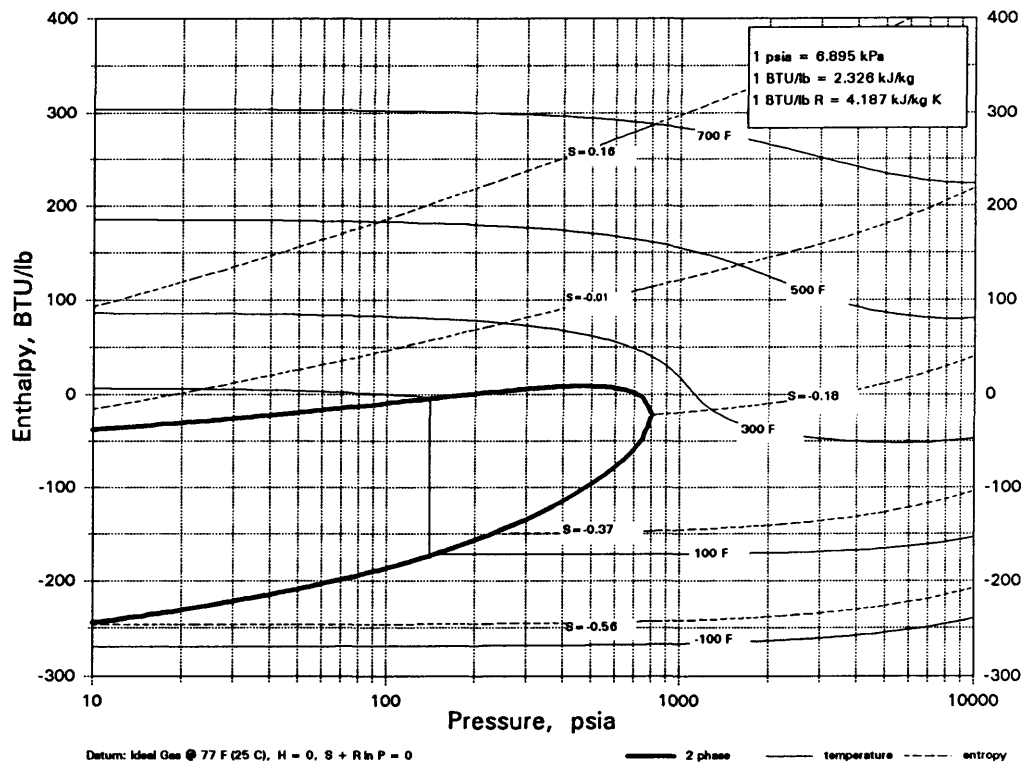
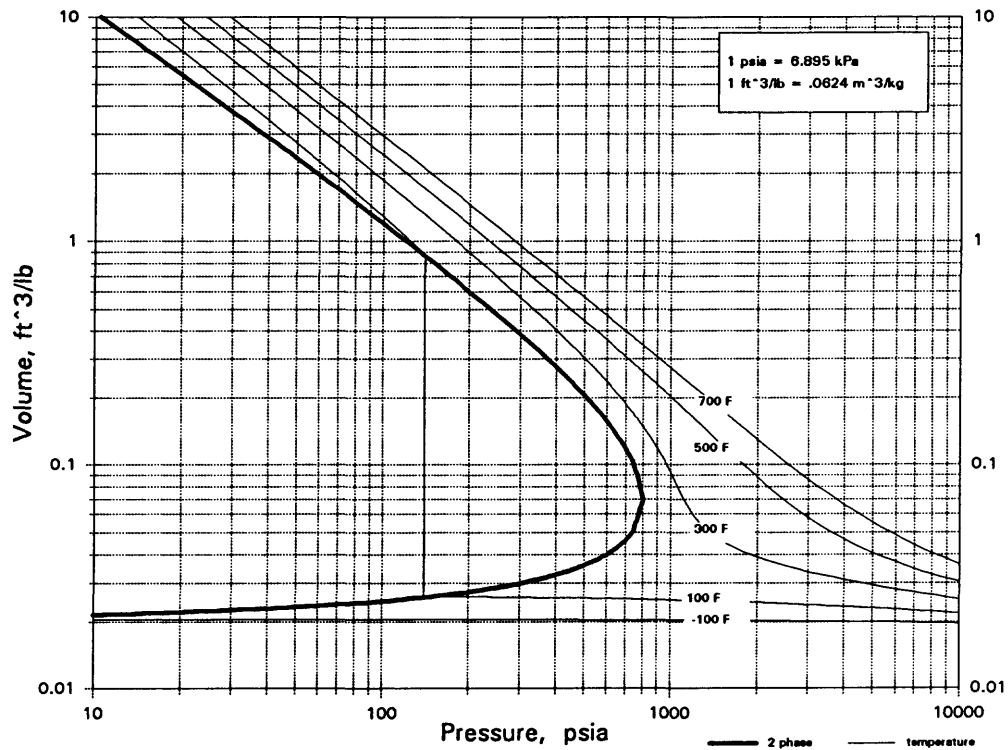
C3H5N3O9 NITROGLYCERINE



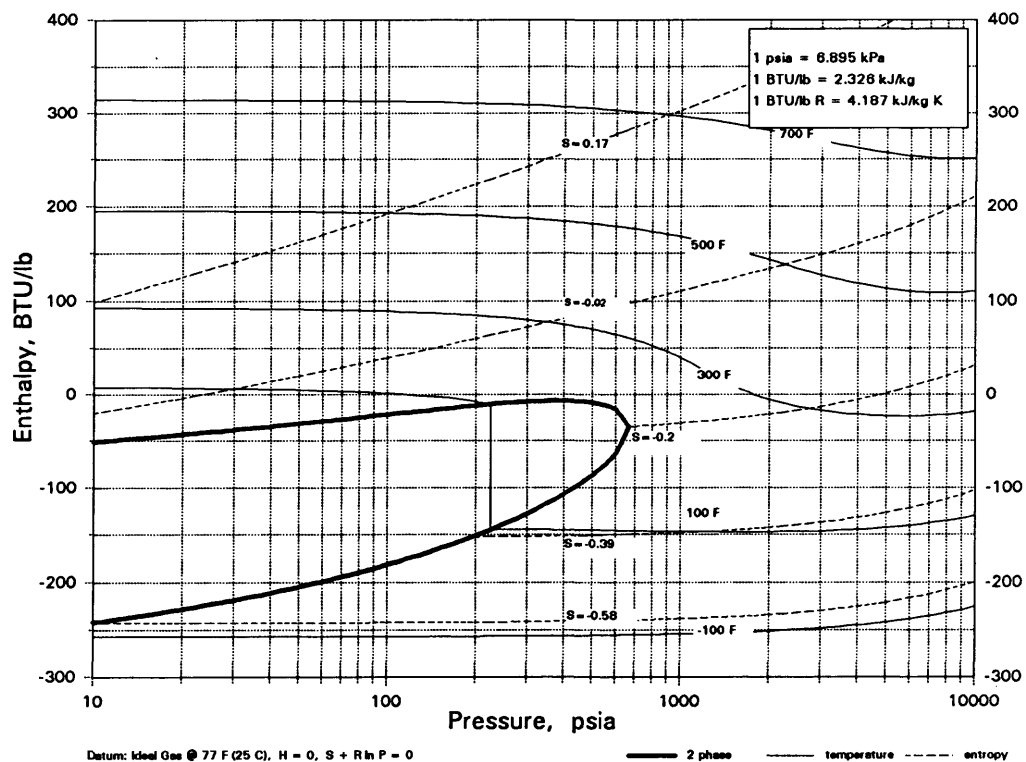
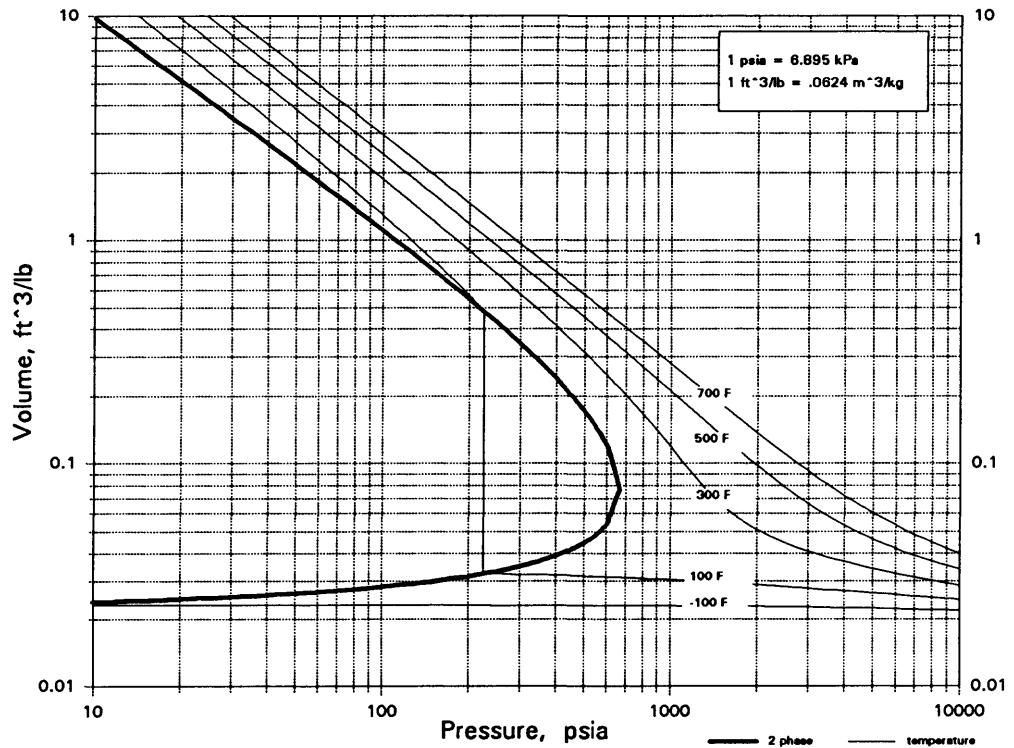
1. Boiling Point, K..... 523.00
2. Critical Temperature, K.... 680.00
3. Critical Pressure, atm..... 29.61

Heat capacity data are not available.

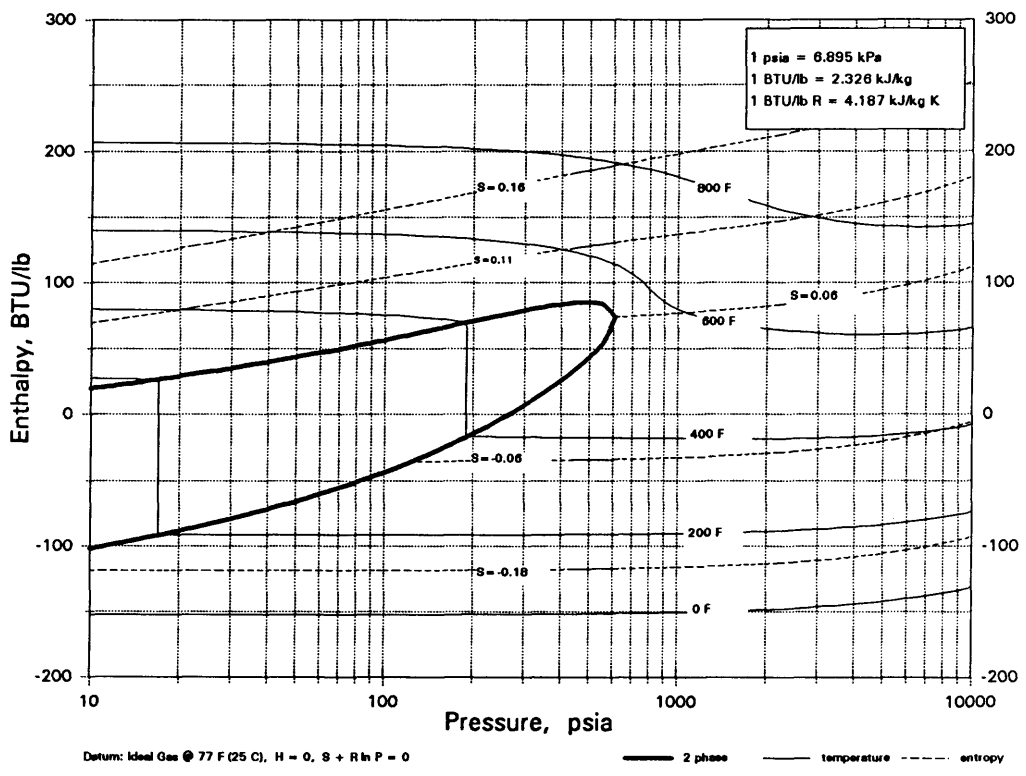
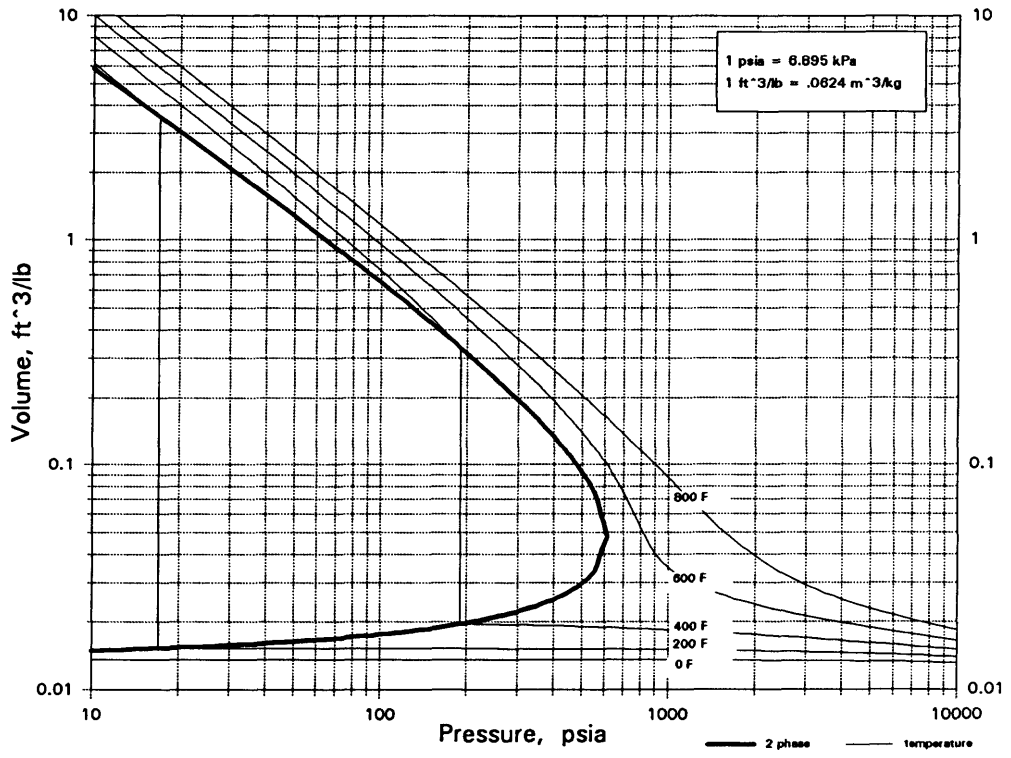
C3H6
CYCLOPROPANE



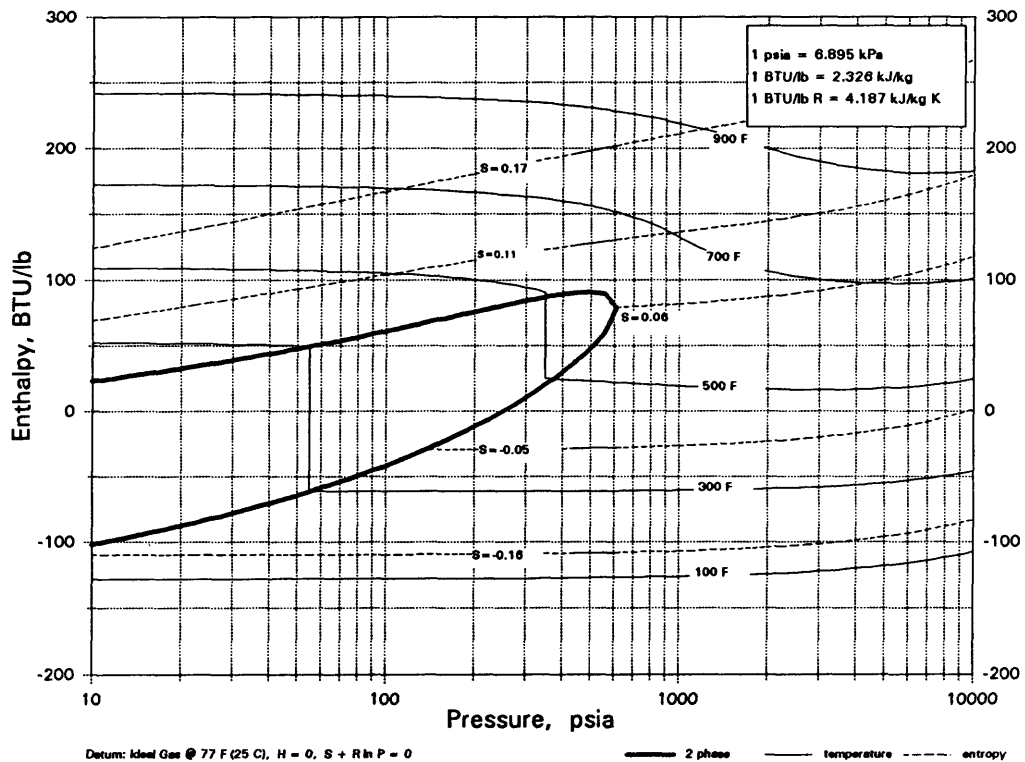
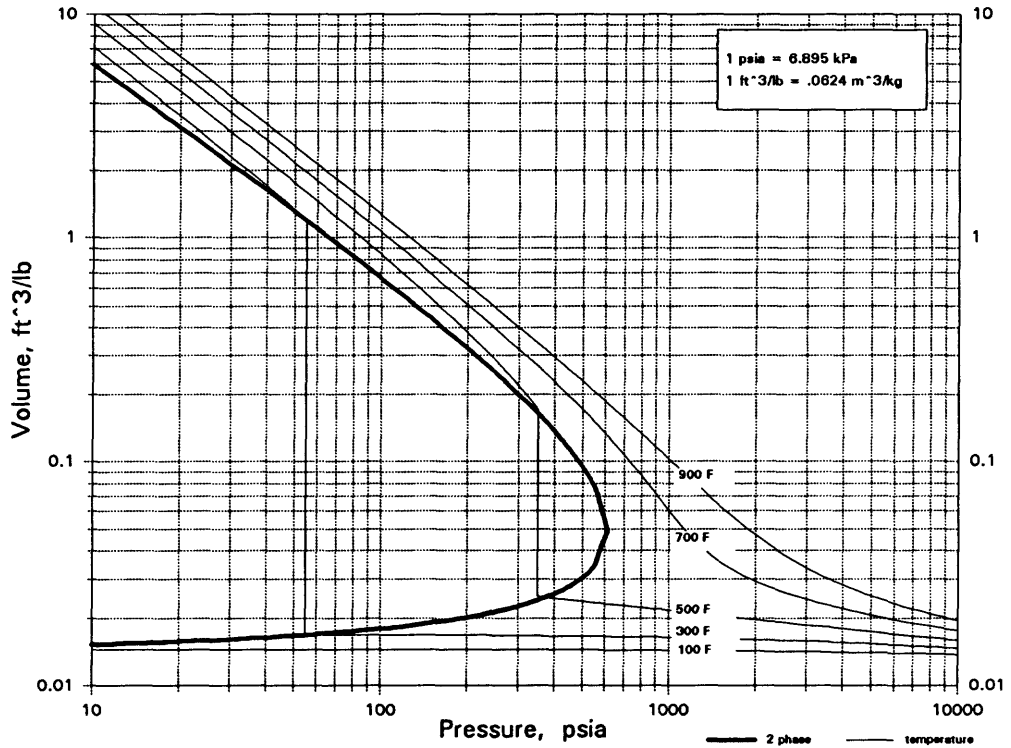
C3H6
PROPYLENE



C3H6Cl2
1-1-DICHLOROPROPANE

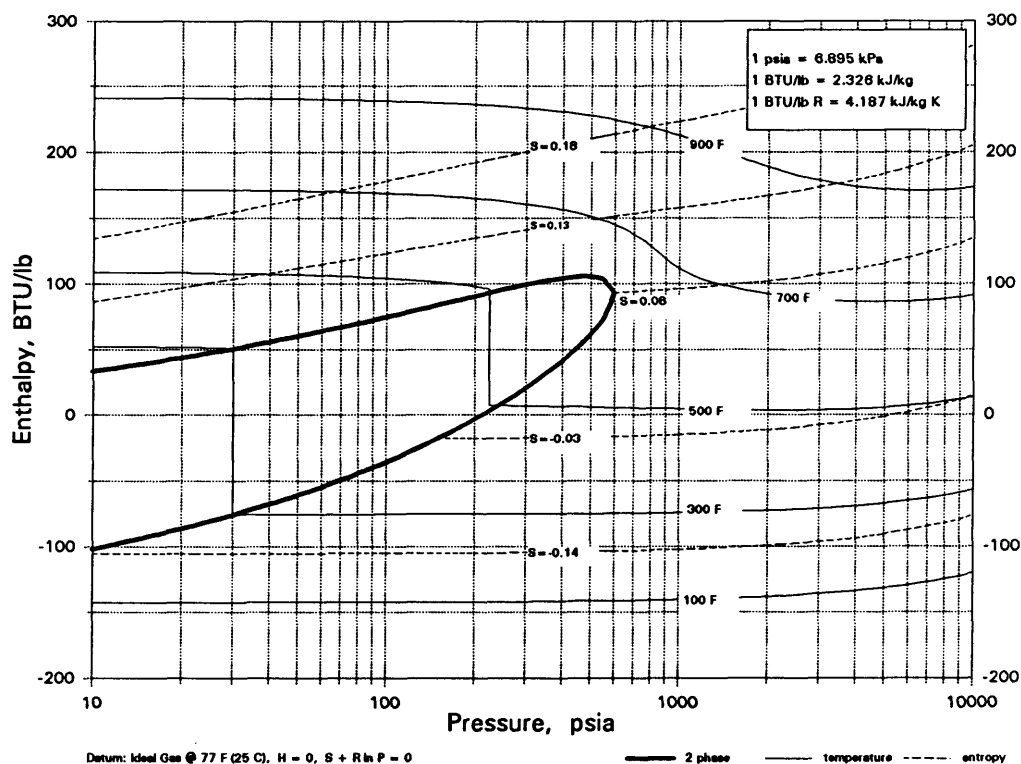
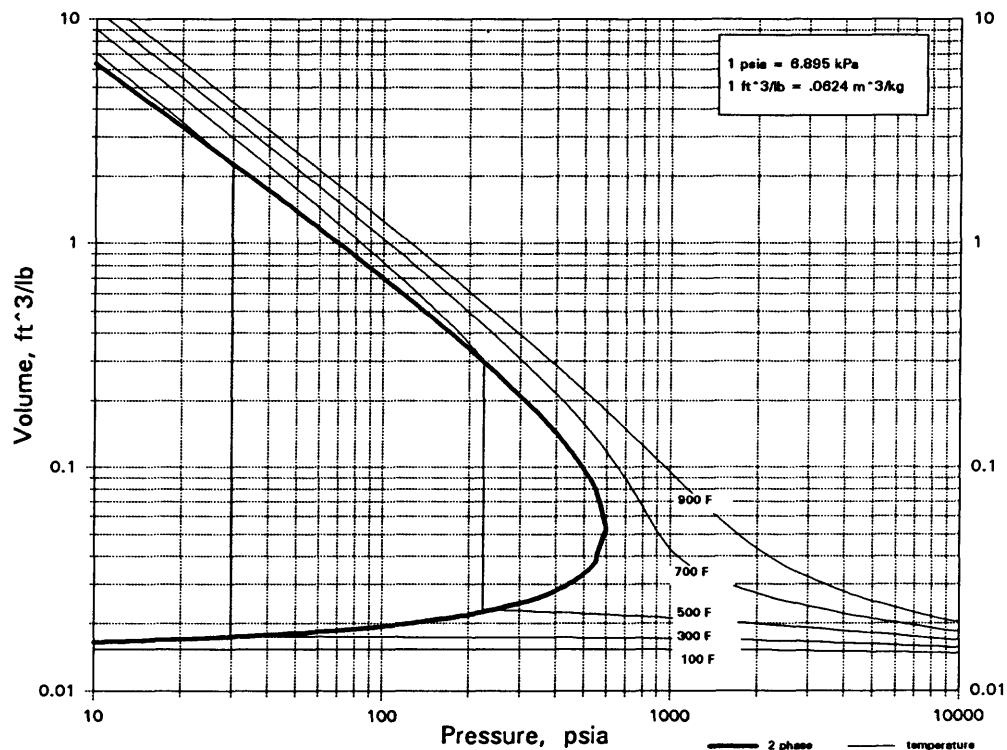


C3H6Cl2
1-2-DICHLOROPROPANE

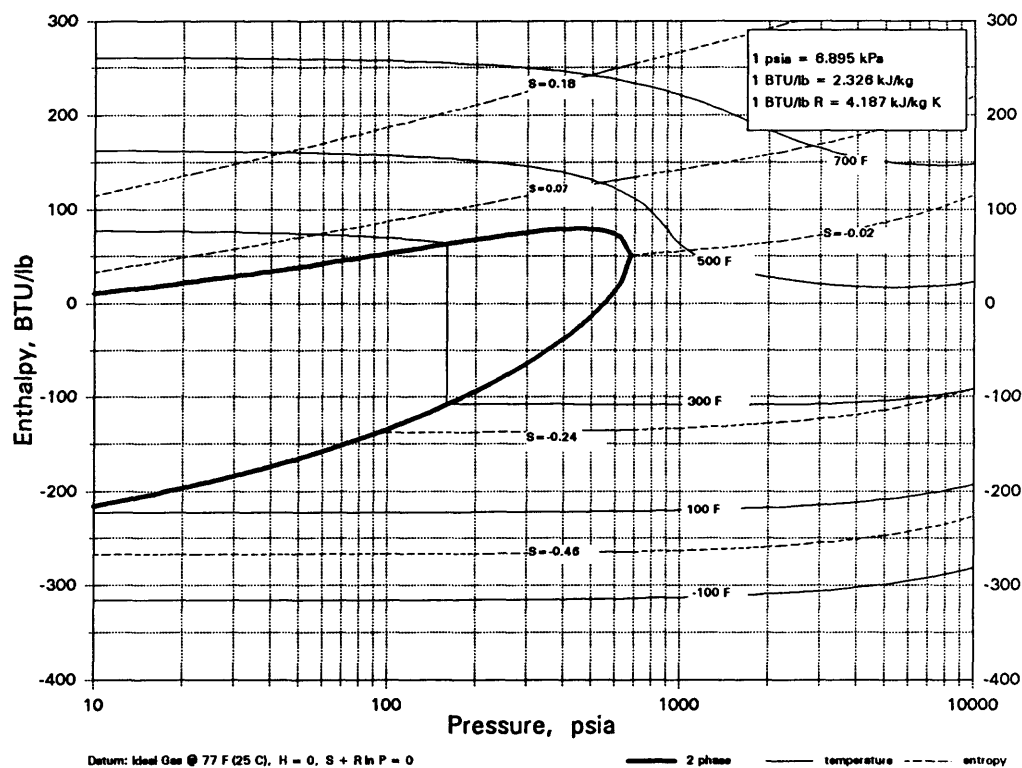
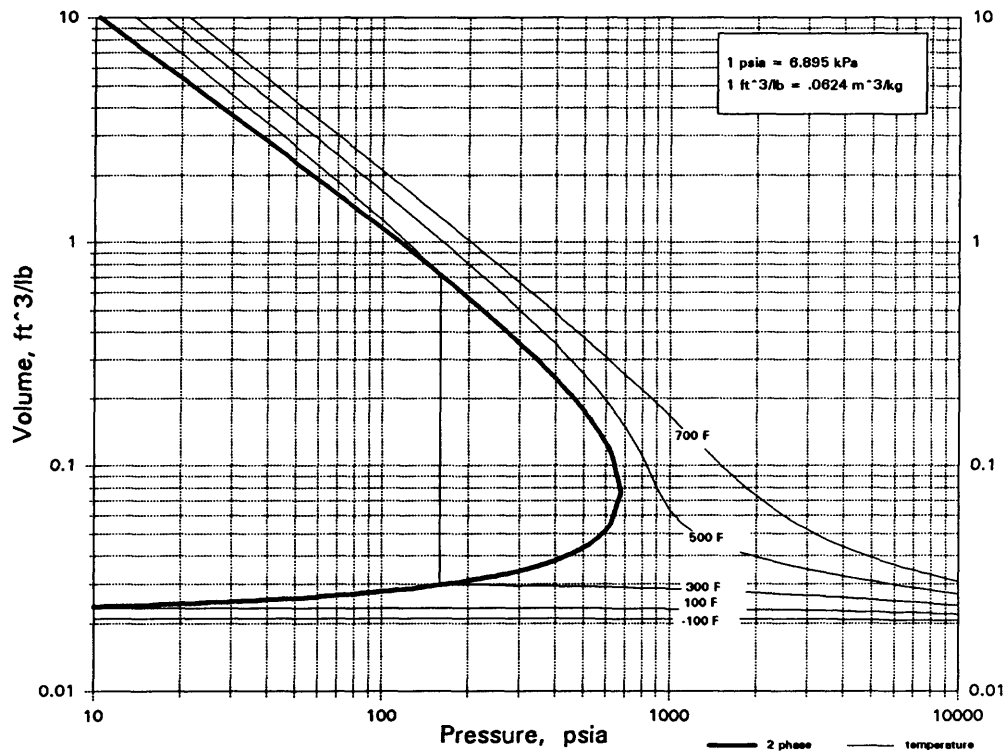


C3H6Cl2

1-3-DICHLOROPROPANE

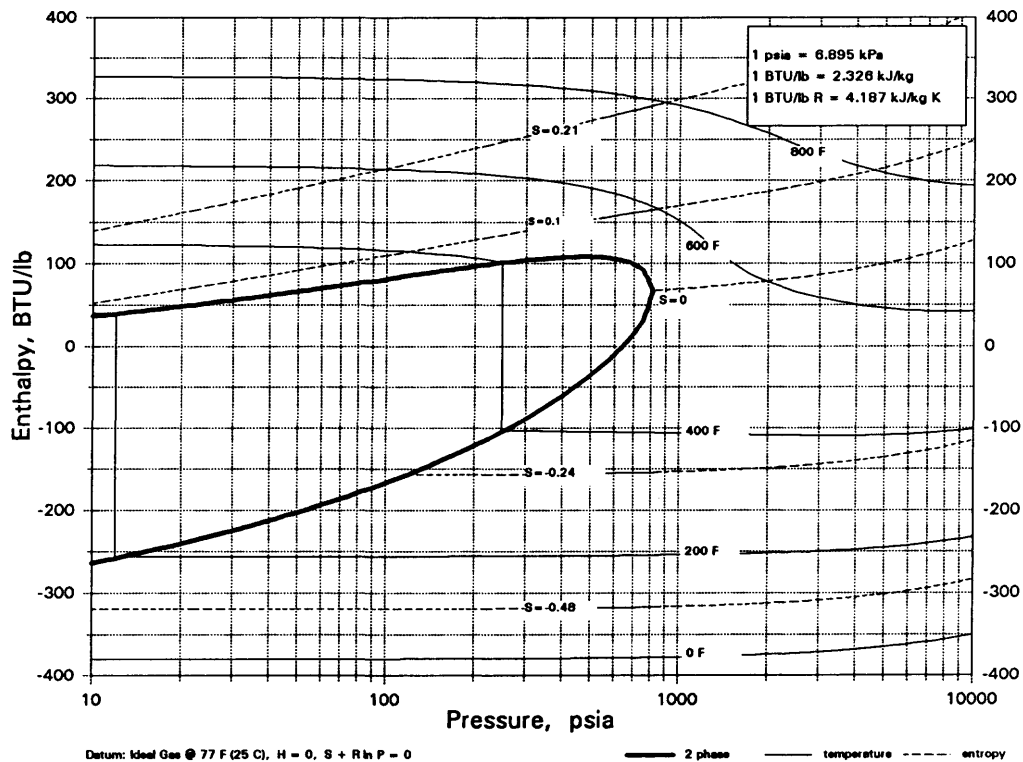
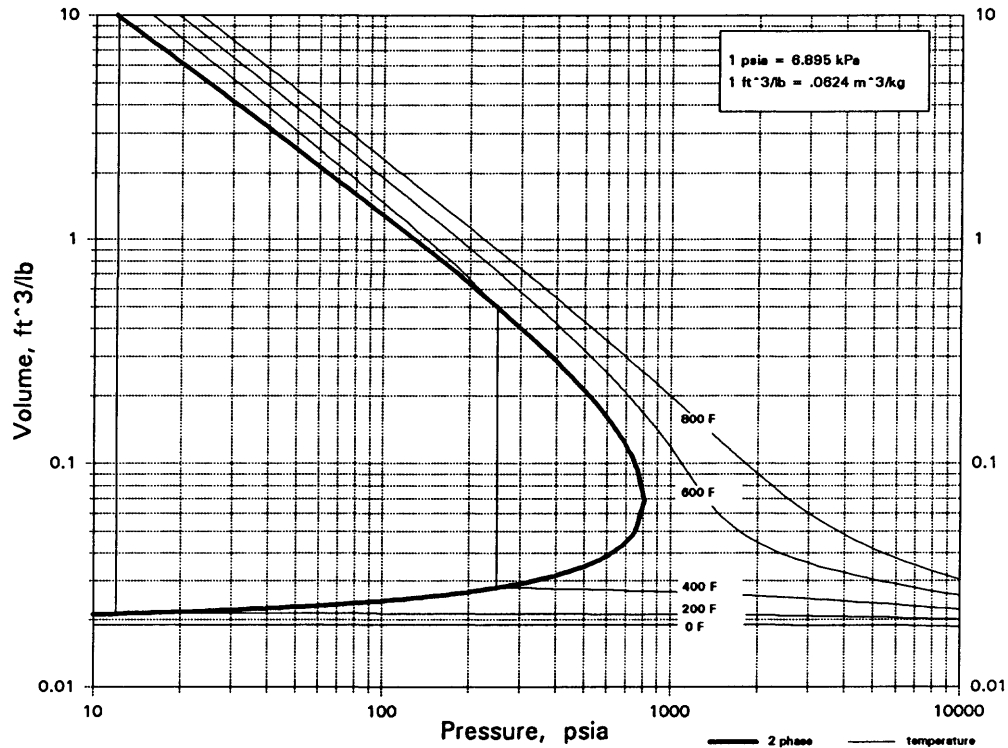


C3H6O
ACETONE

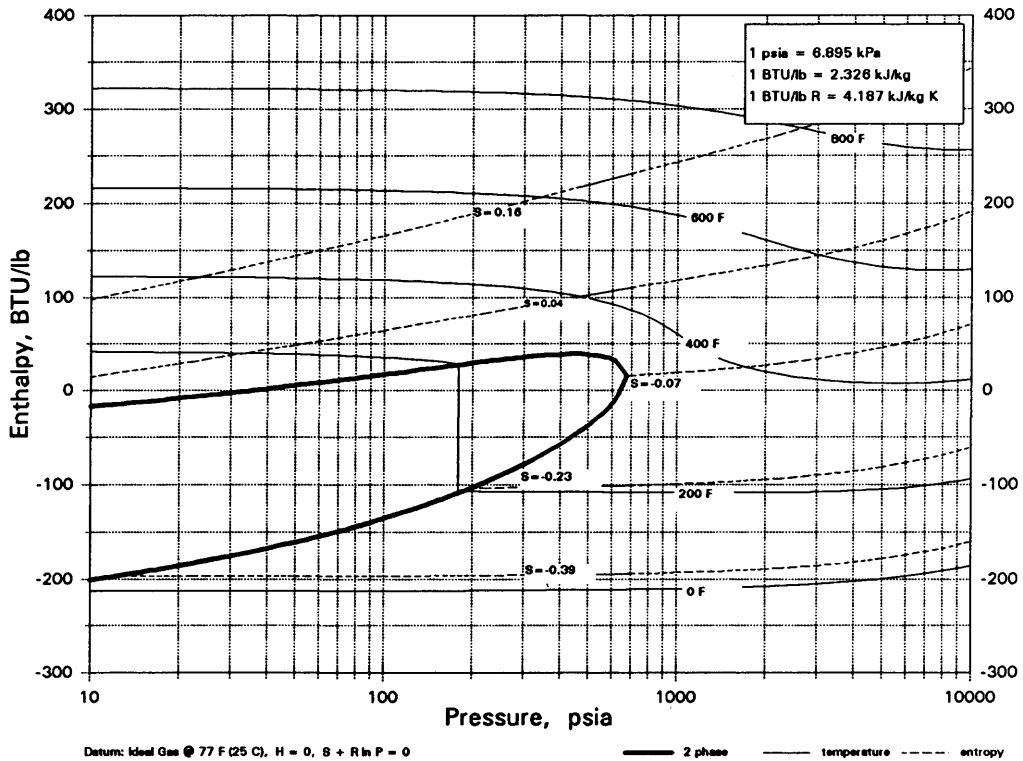
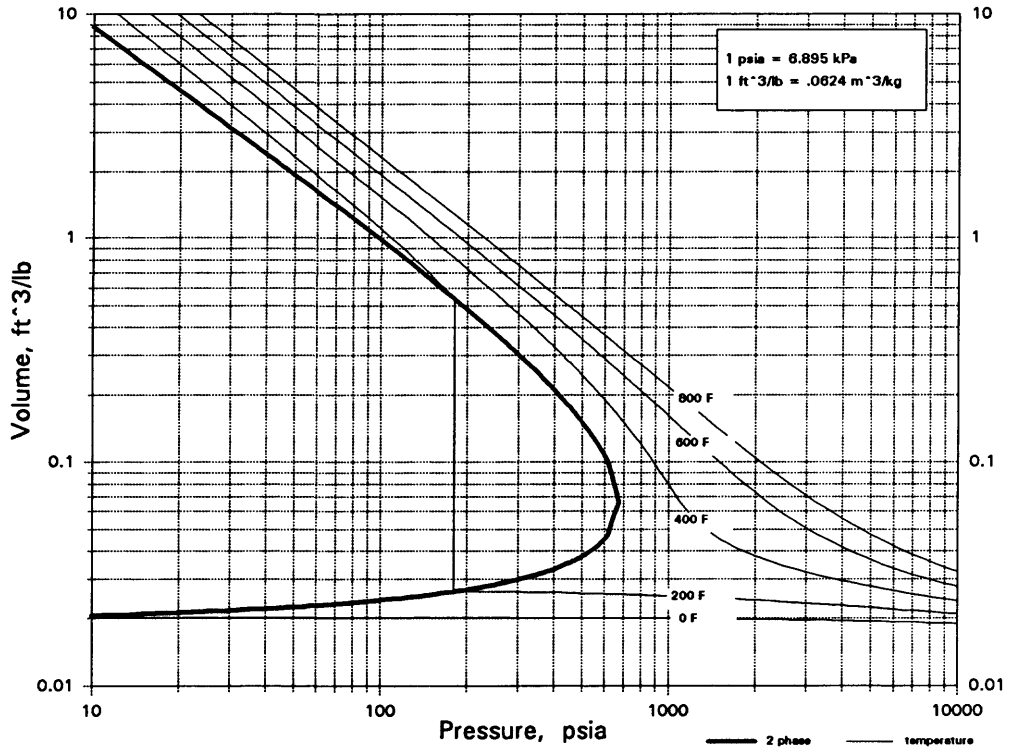


C3H6O

ALLYL ALCOHOL

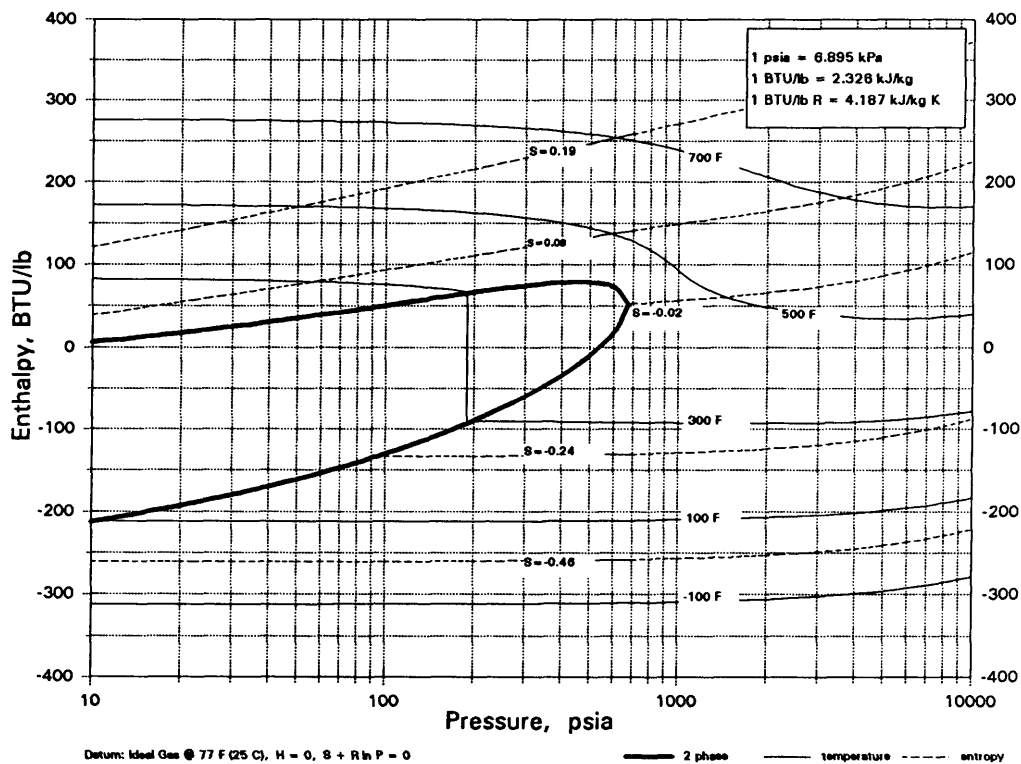
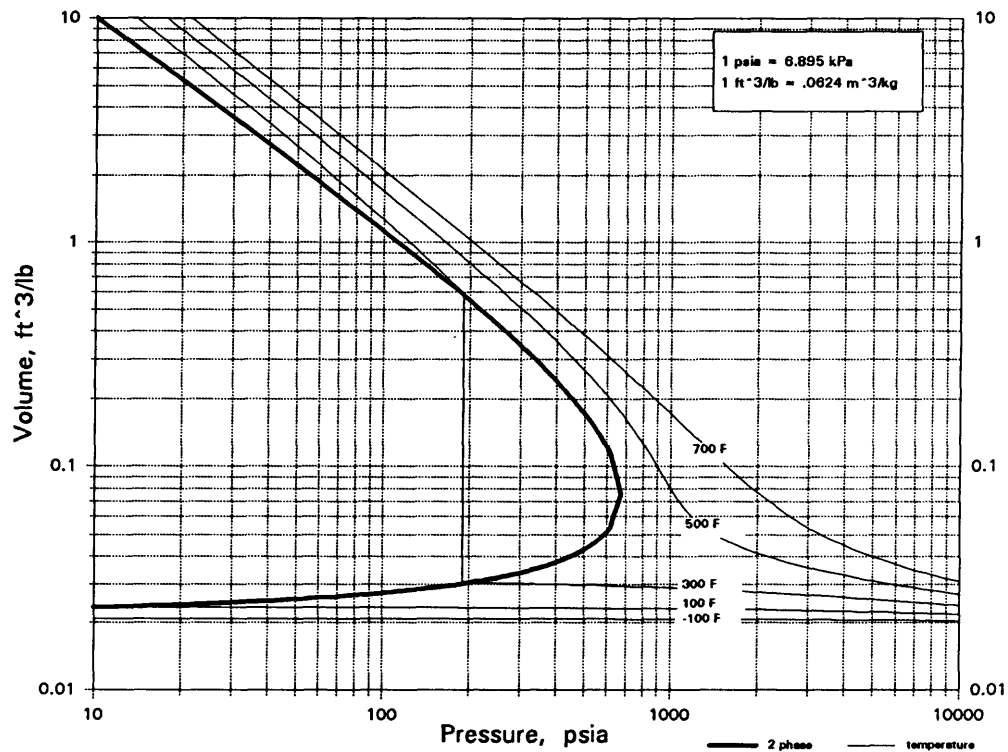


C3H6O
METHYL VINYL ETHER



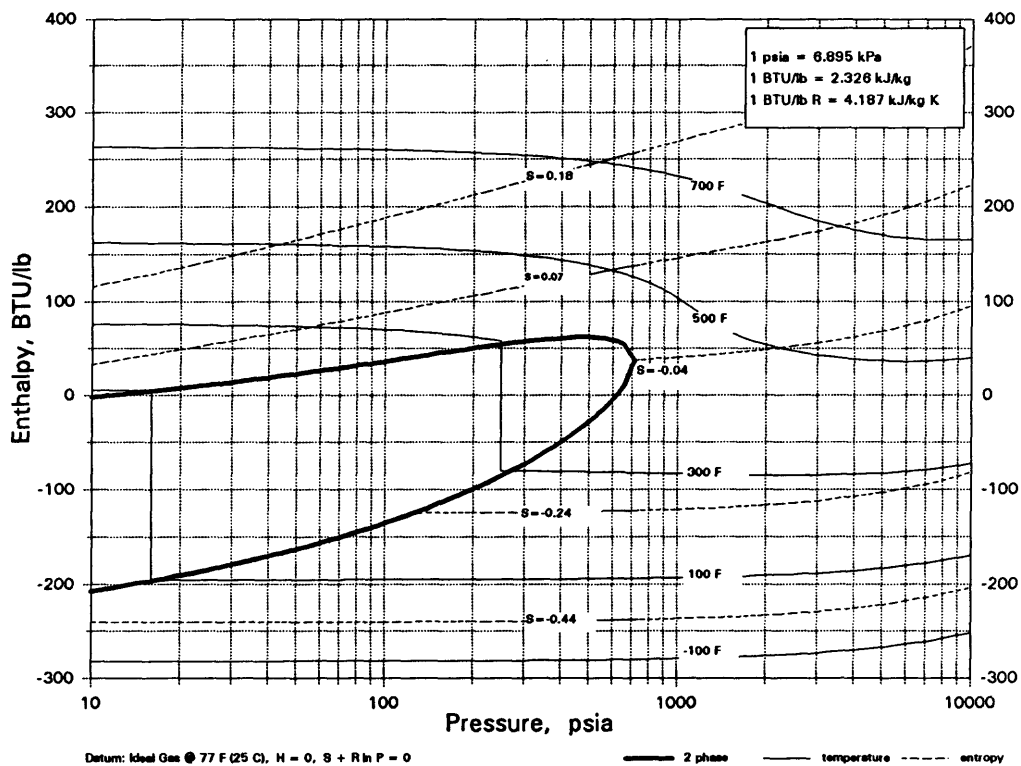
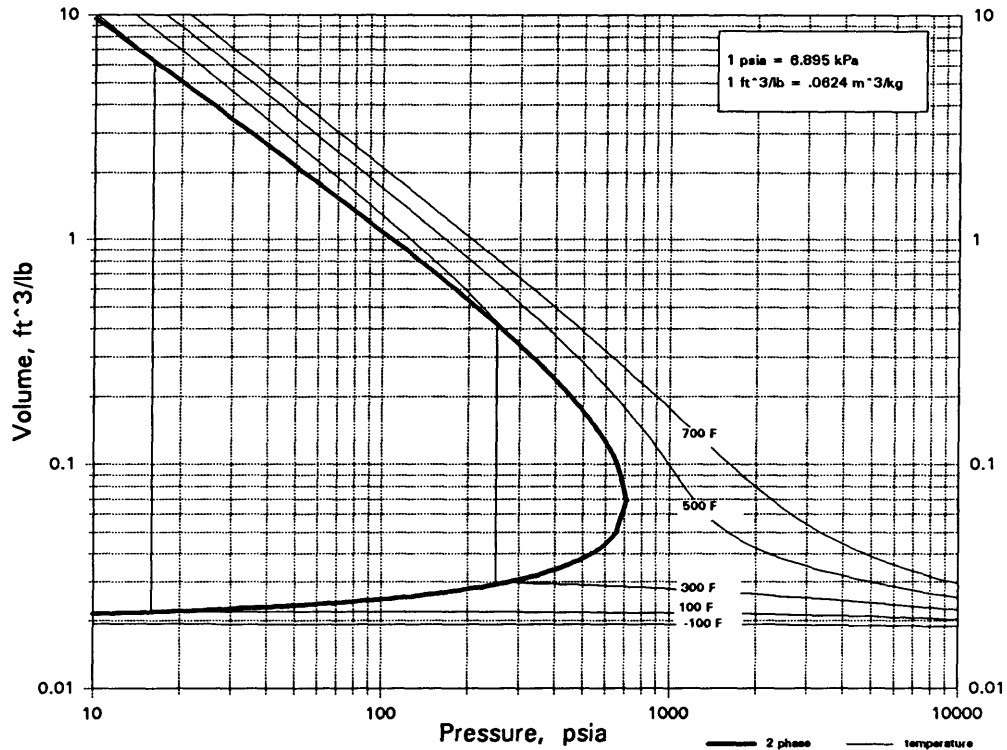
C3H6O

n-PROPIONALDEHYDE



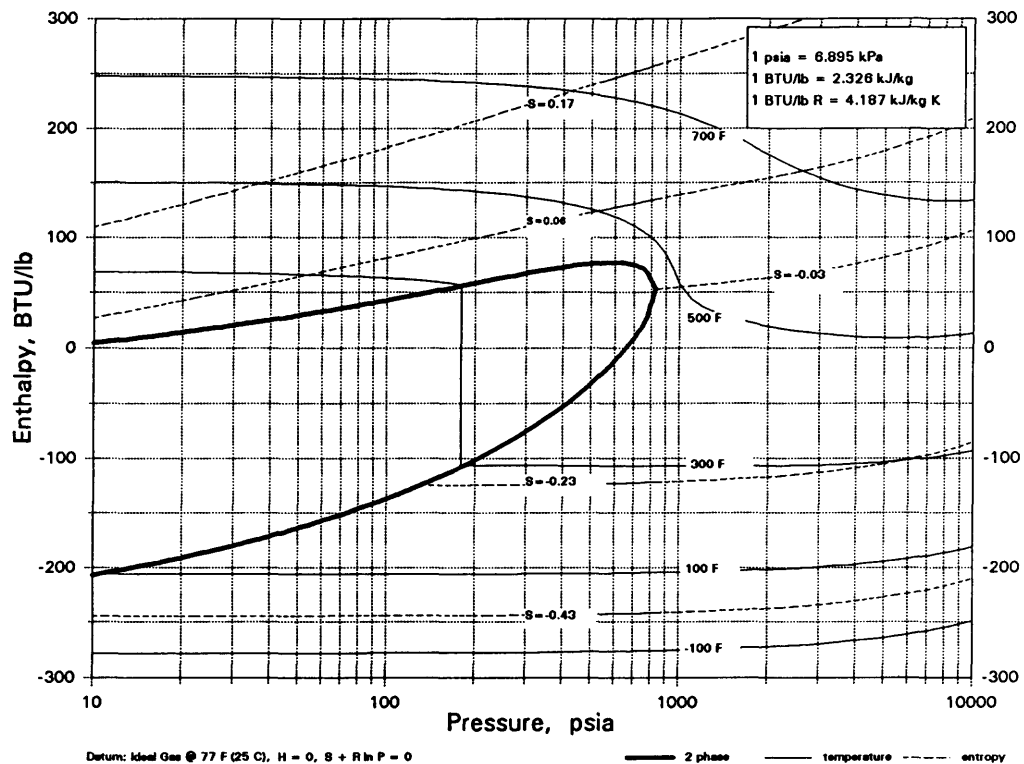
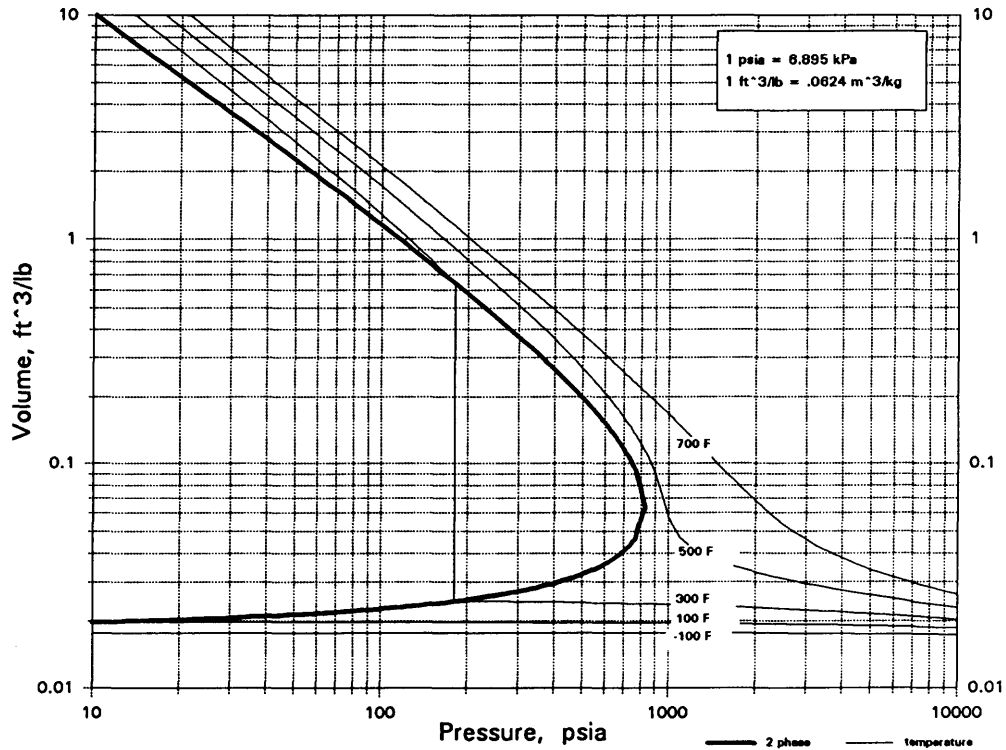
C3H6O

1-2-PROPYLENE OXIDE



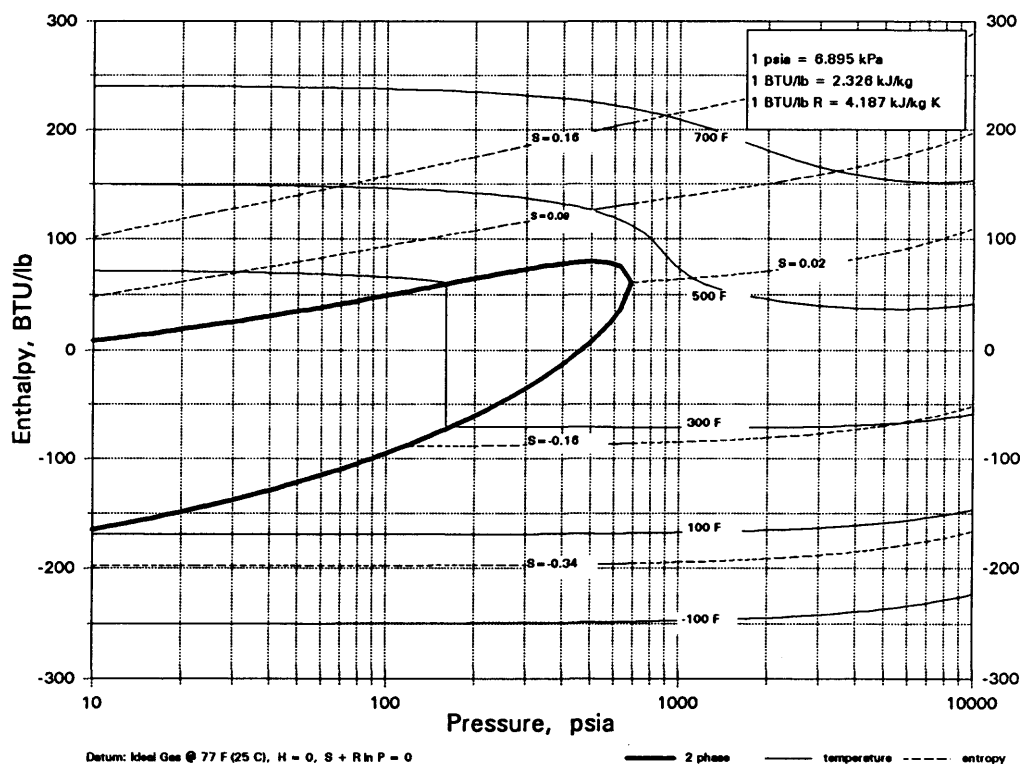
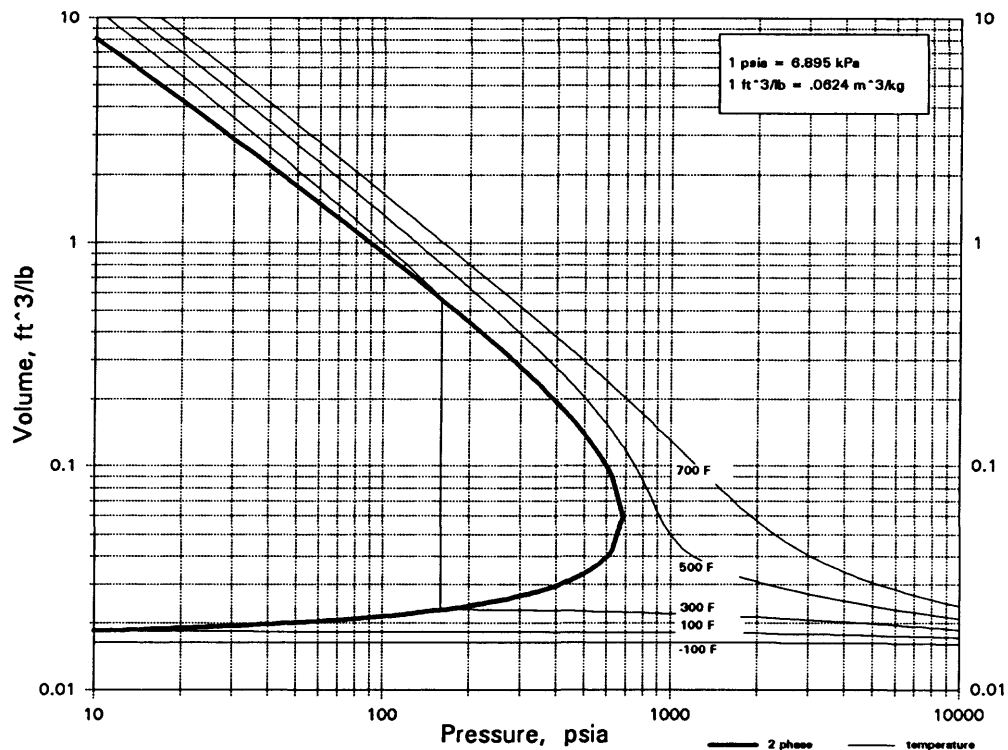
C3H6O

1-3-PROPYLENE OXIDE



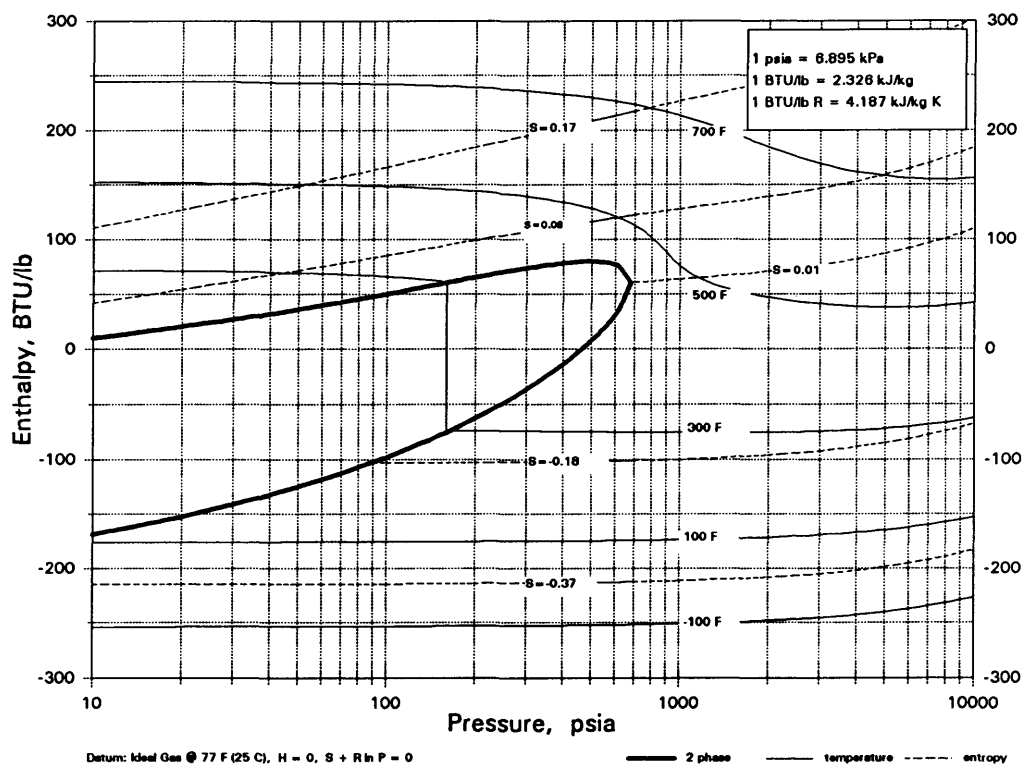
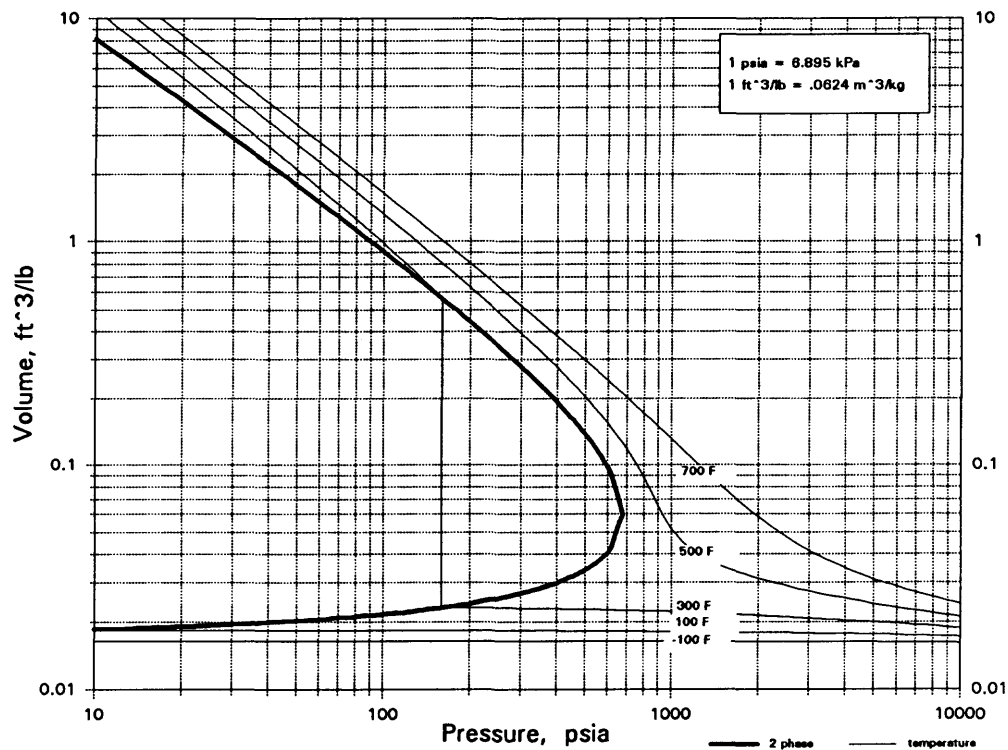
C3H6O2

ETHYL FORMATE



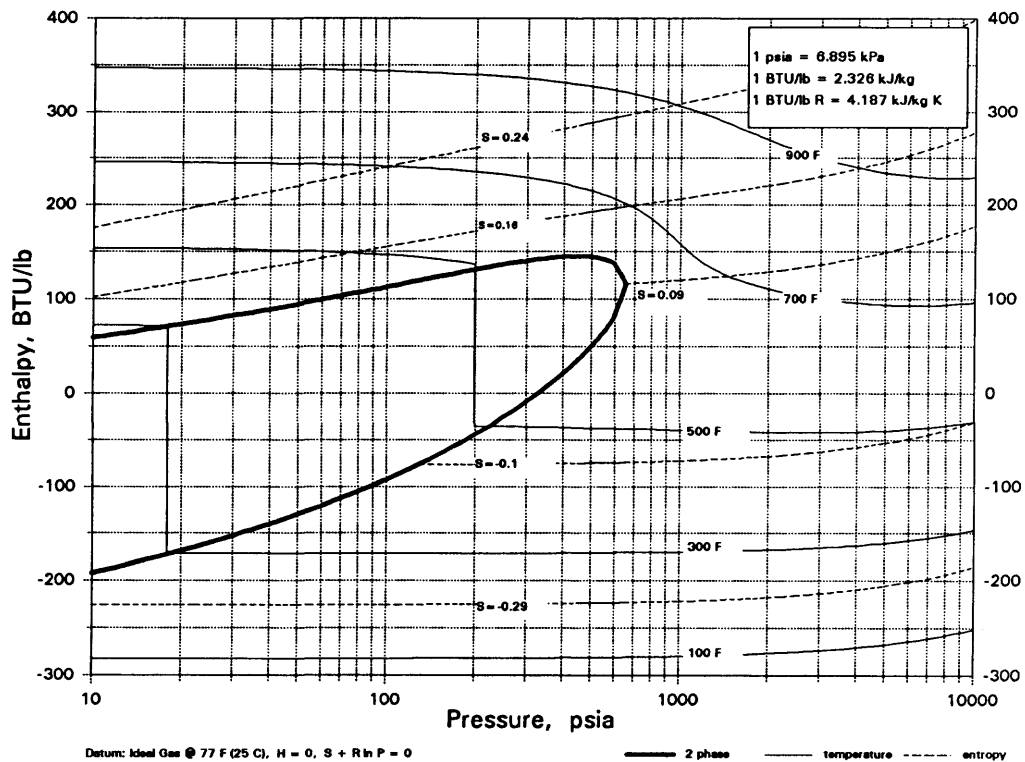
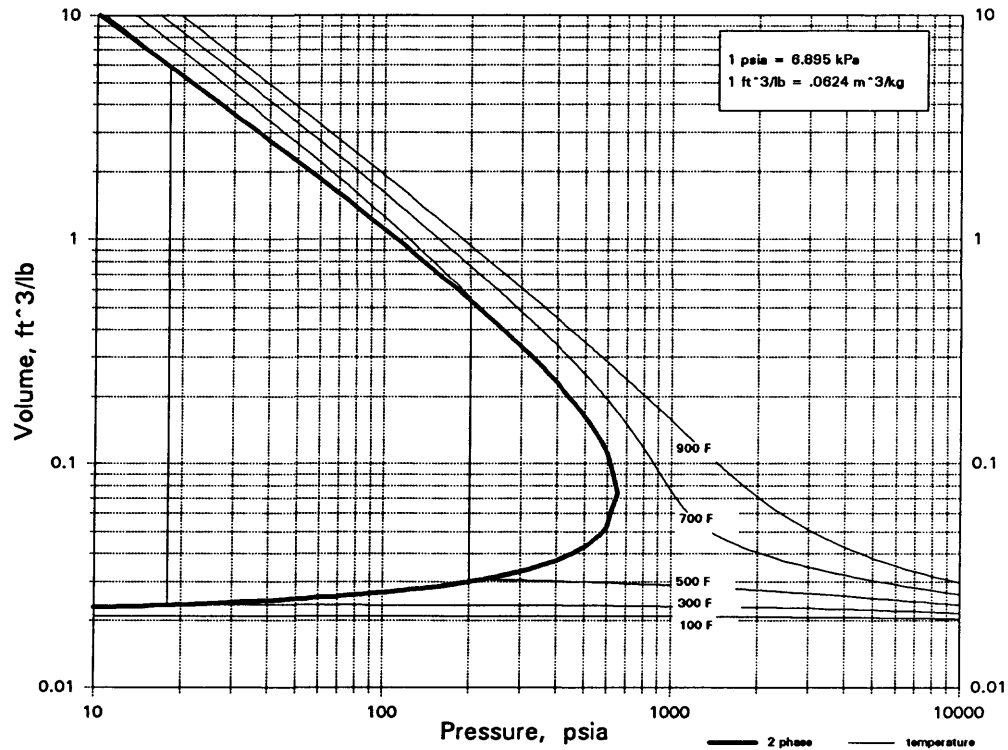
C3H6O2

METHYL ACETATE



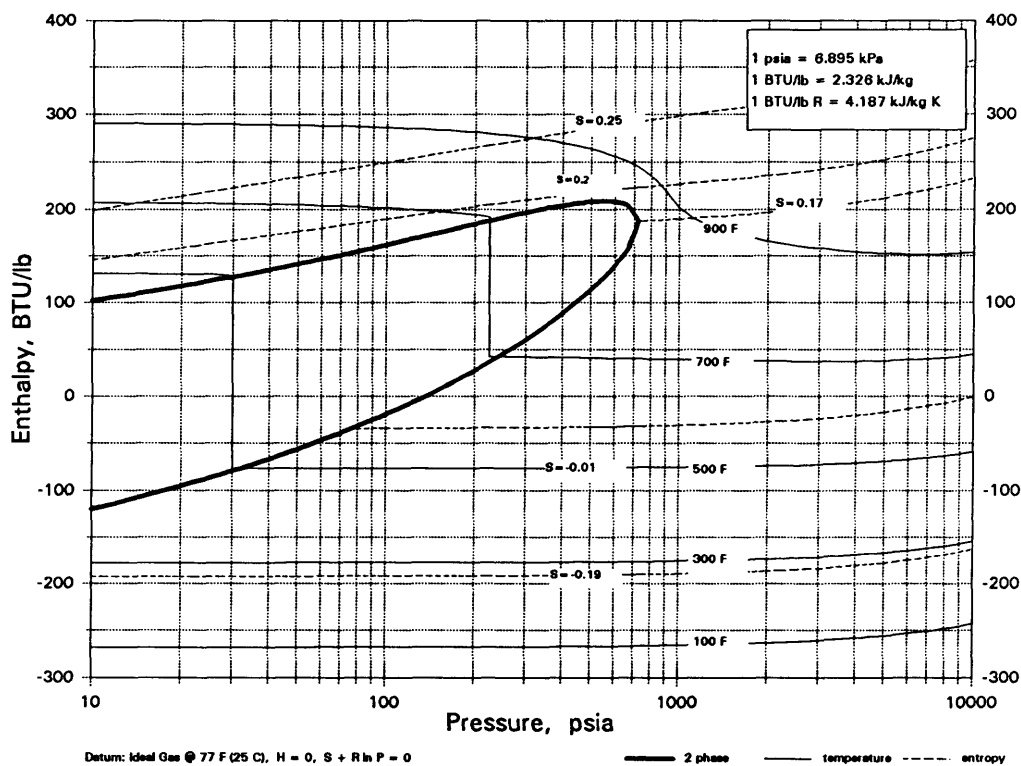
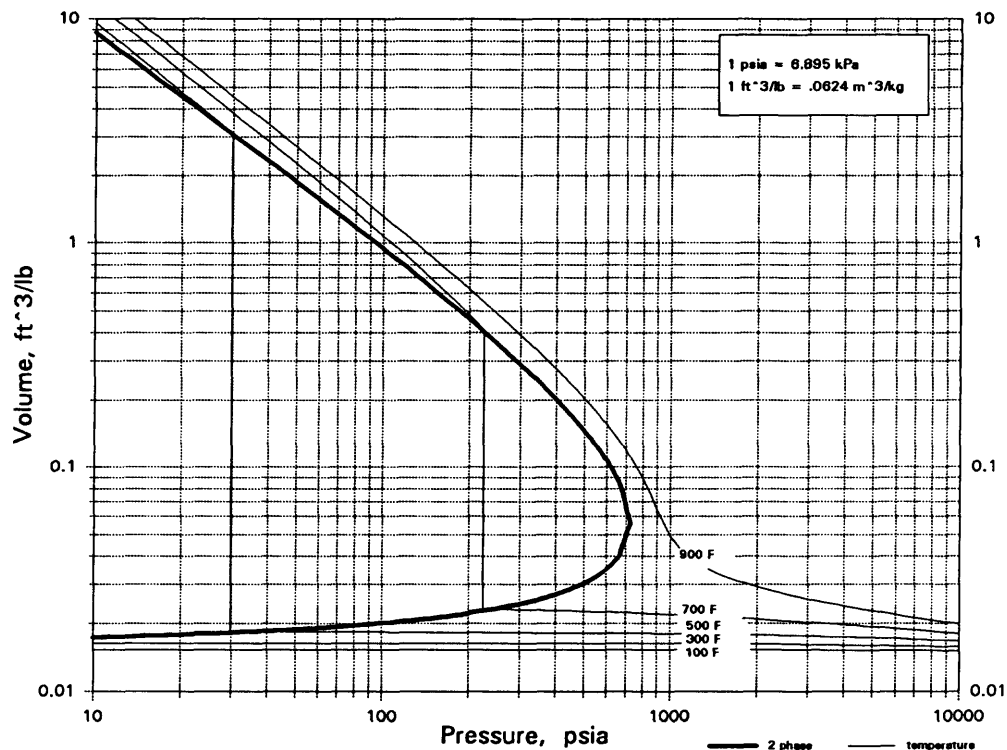
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PROPIONIC ACID



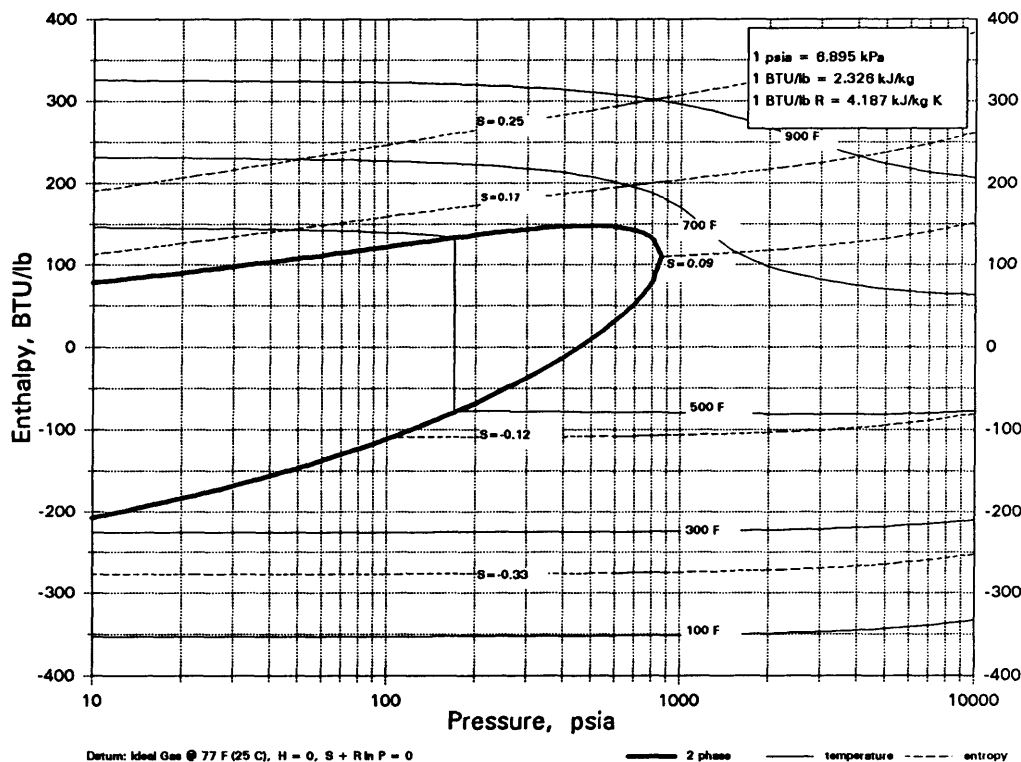
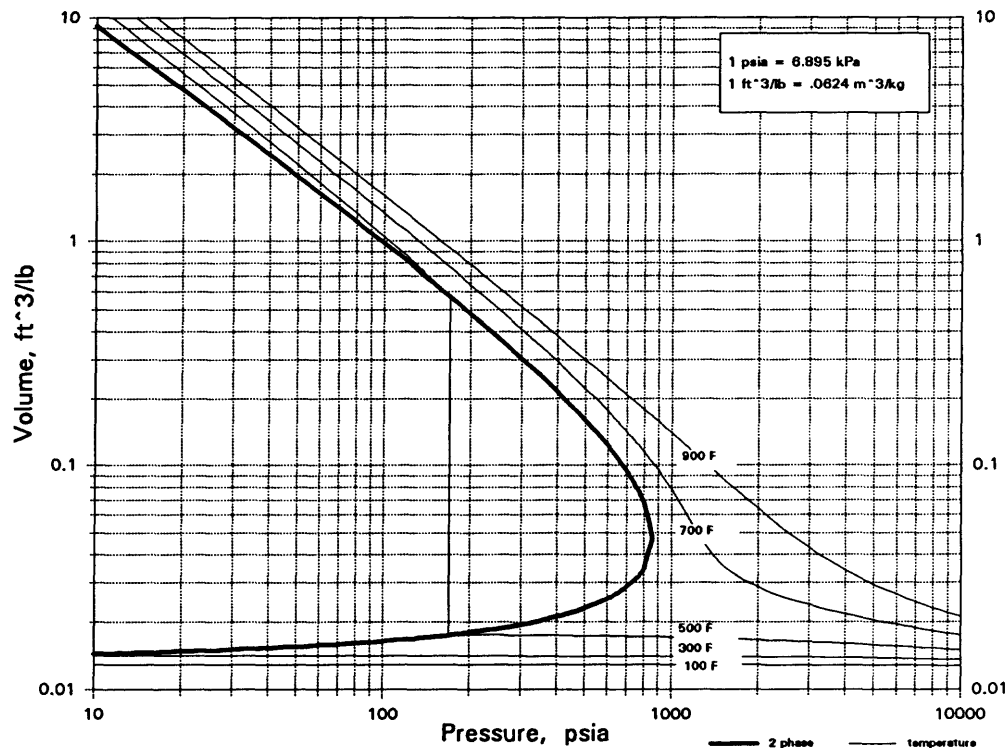
C3H6O2S

3-MERCAPTOPROPIONIC ACID



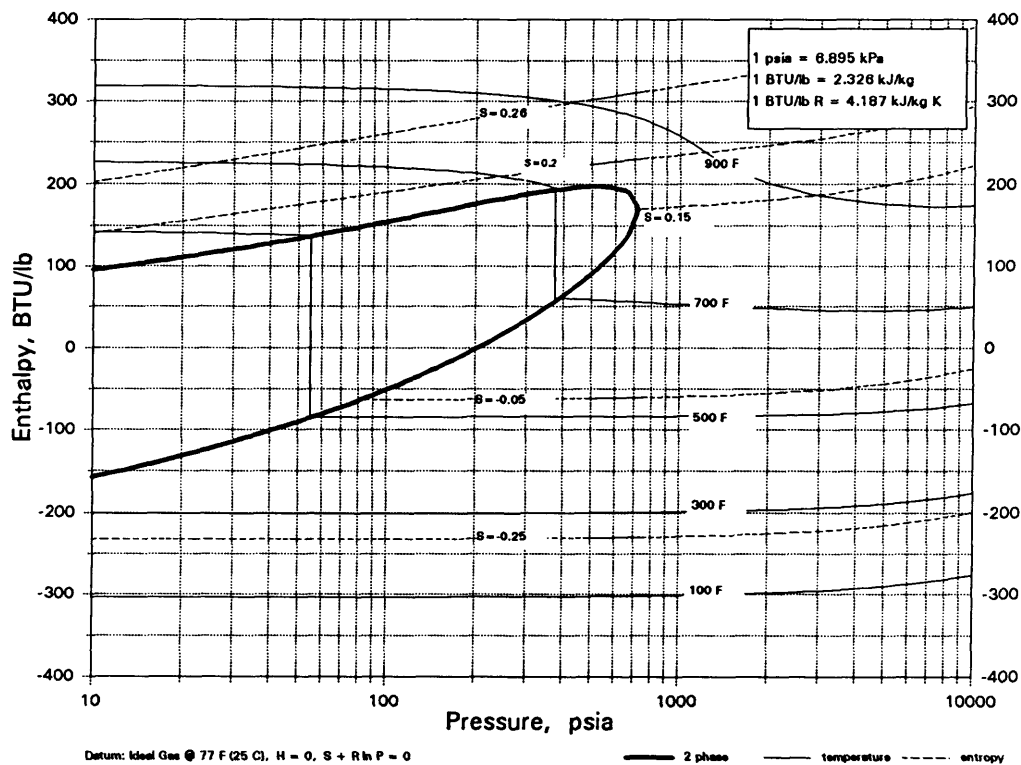
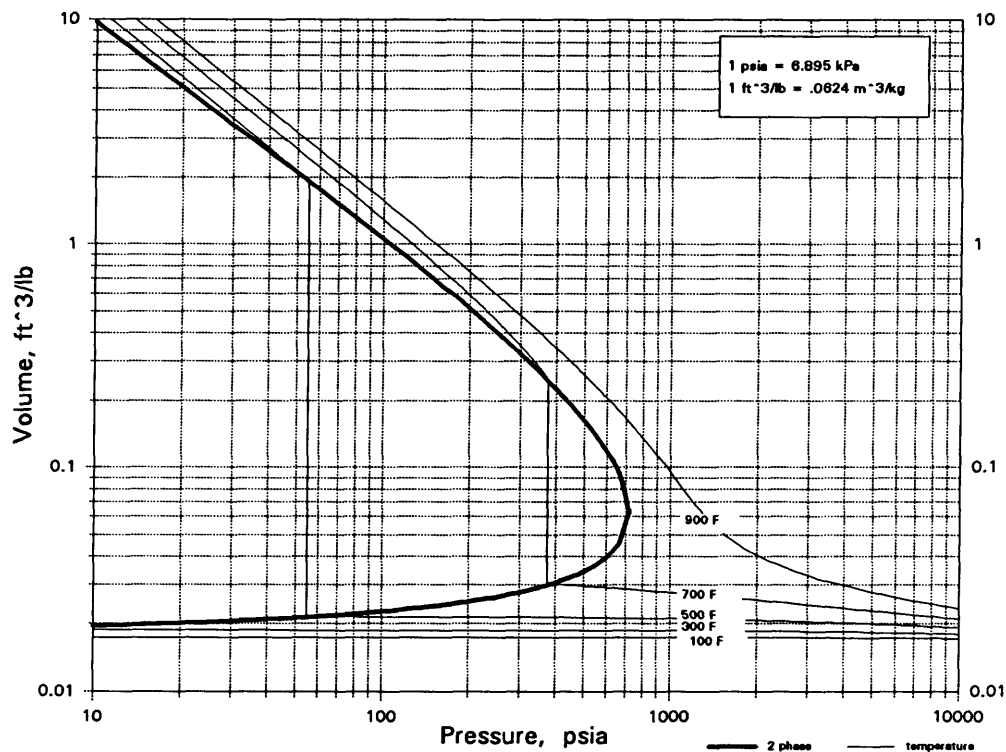
C3H6O3

LACTIC ACID

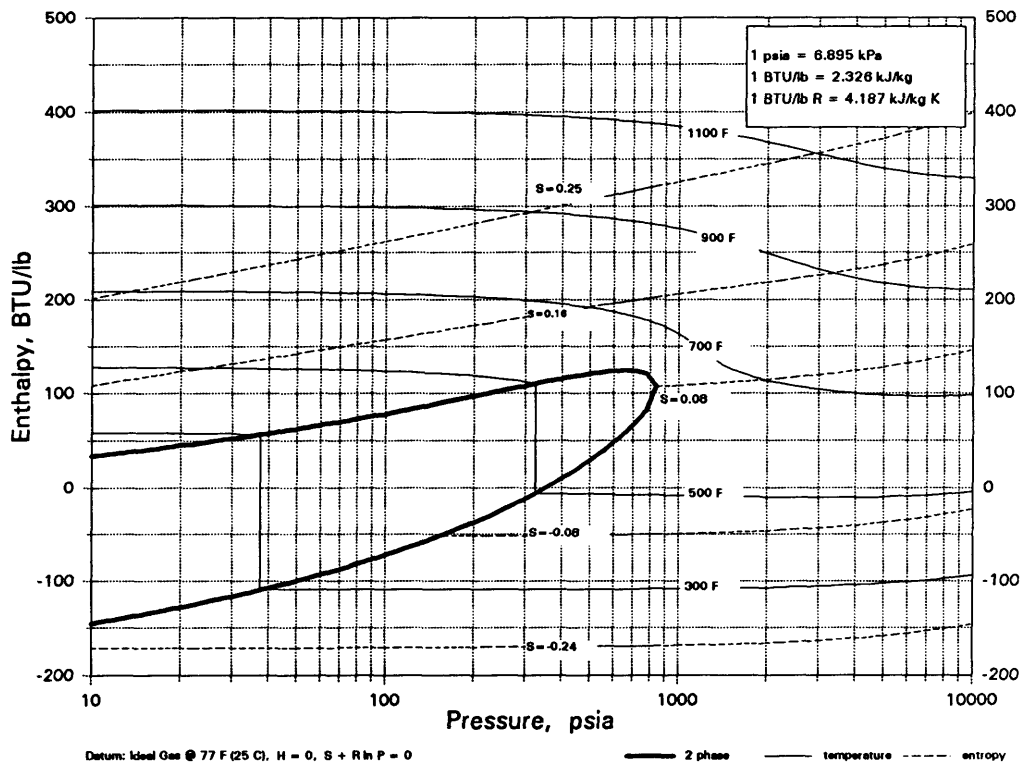
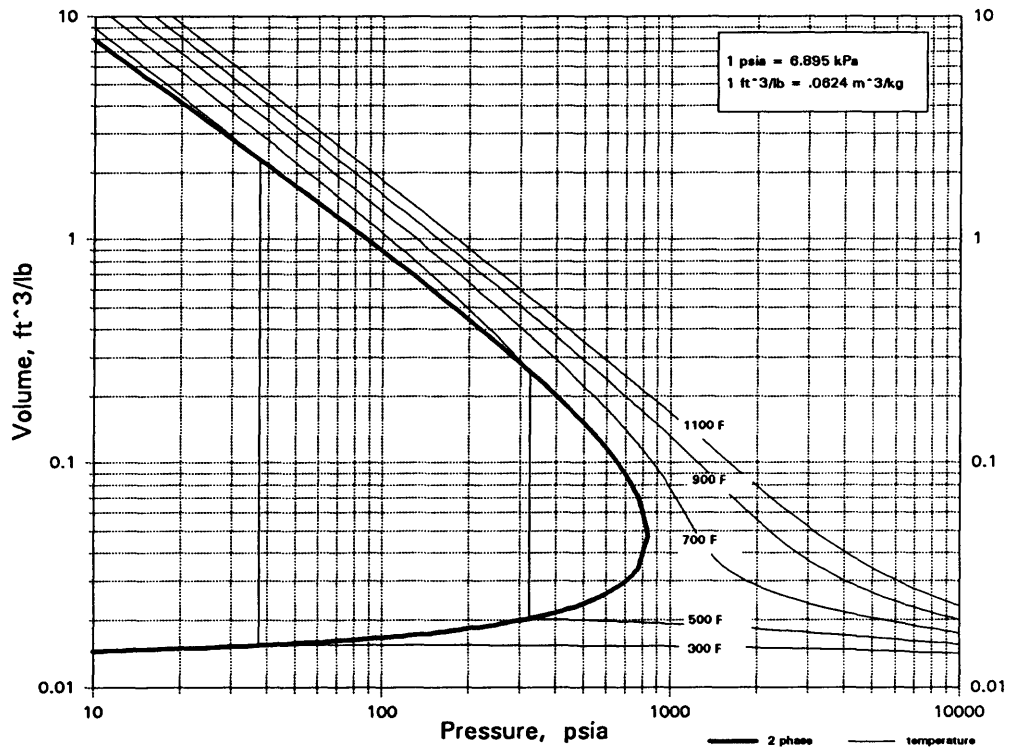


C3H6O3

METHOXYACETIC ACID

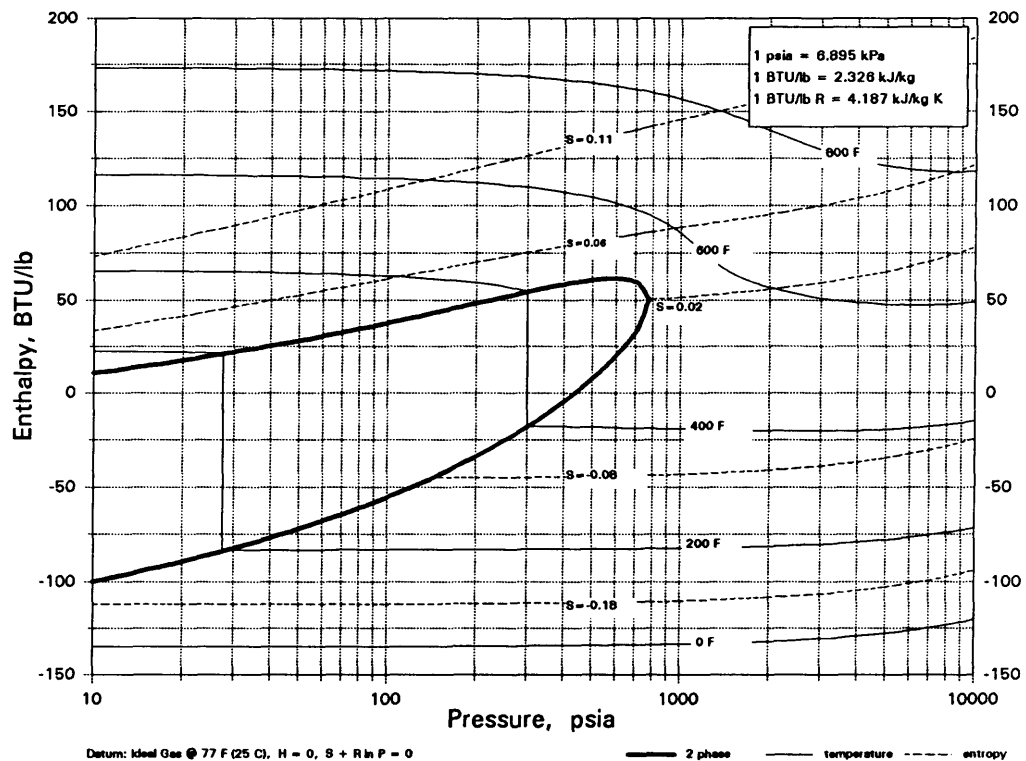
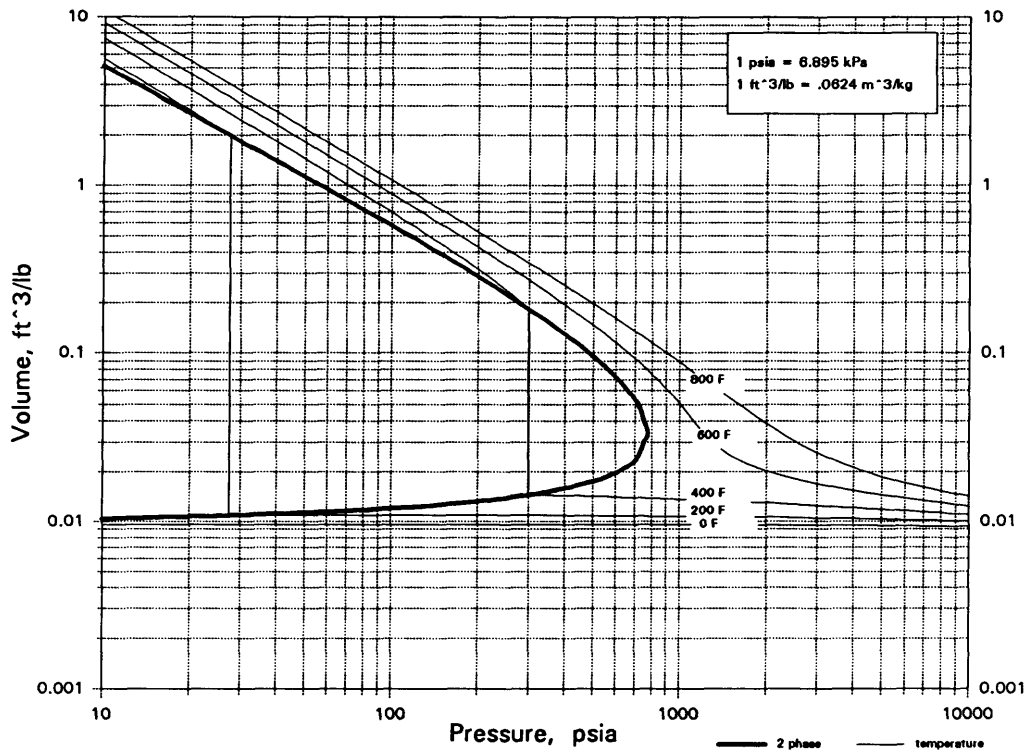


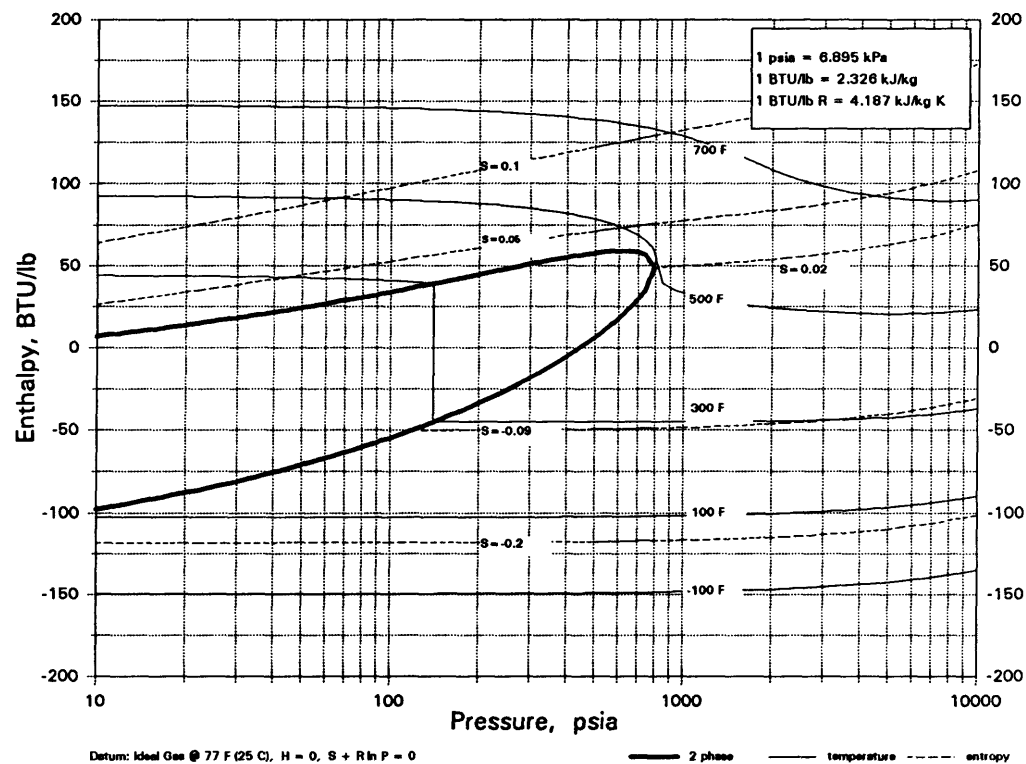
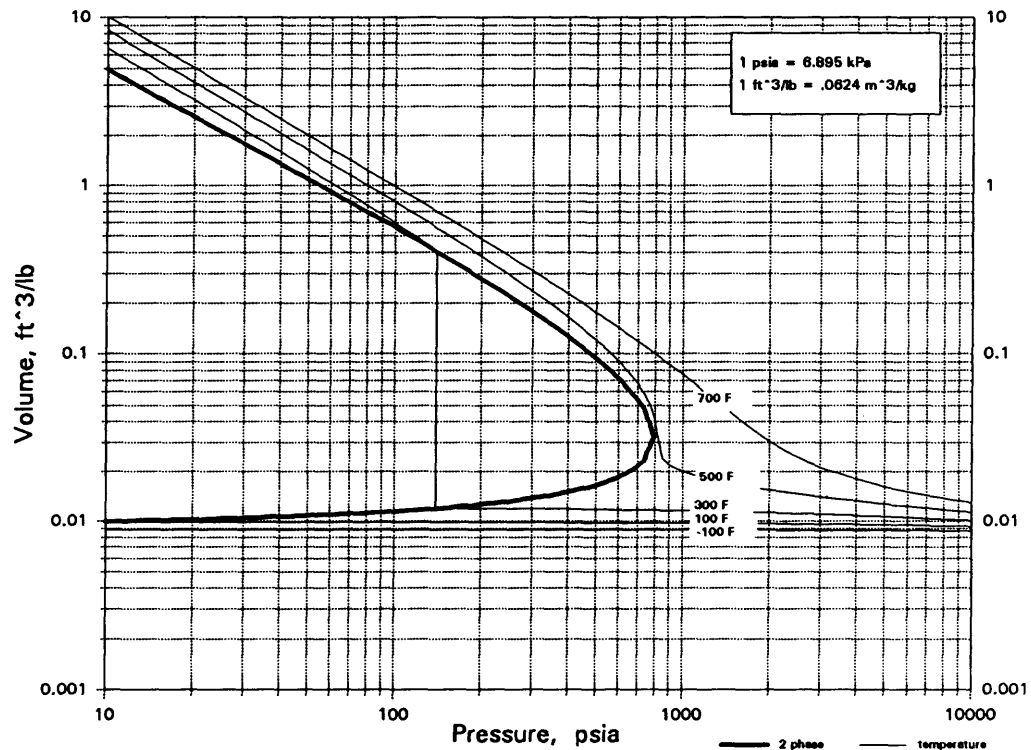
C3H6O3
TRIOXANE



C3H7Br

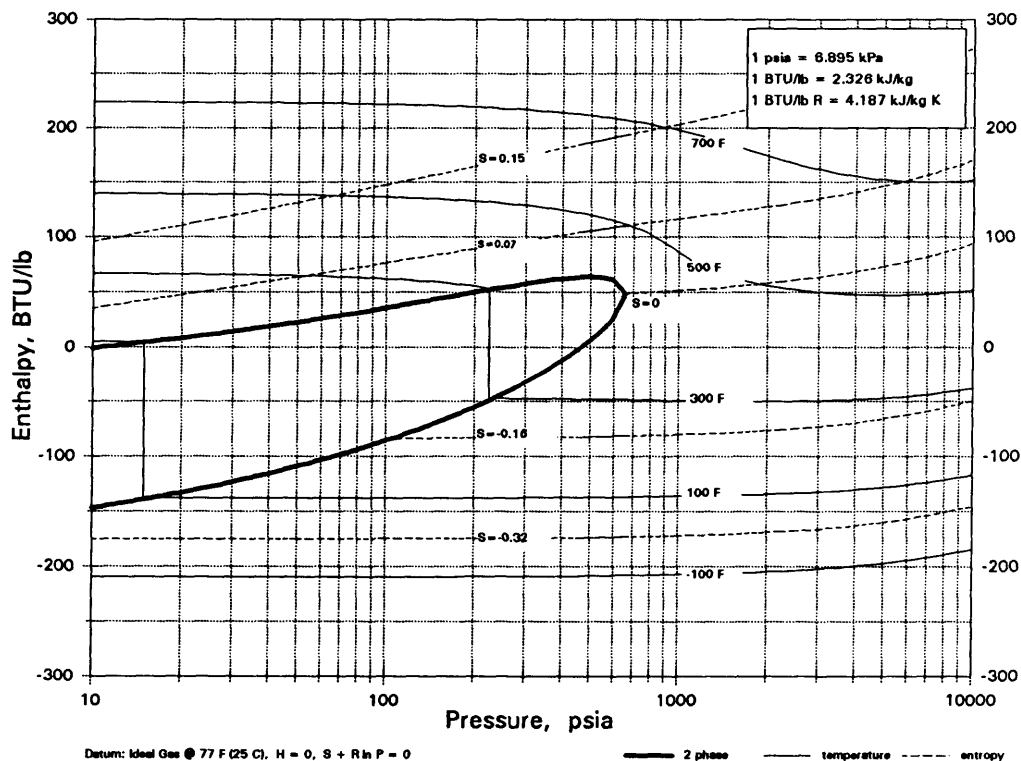
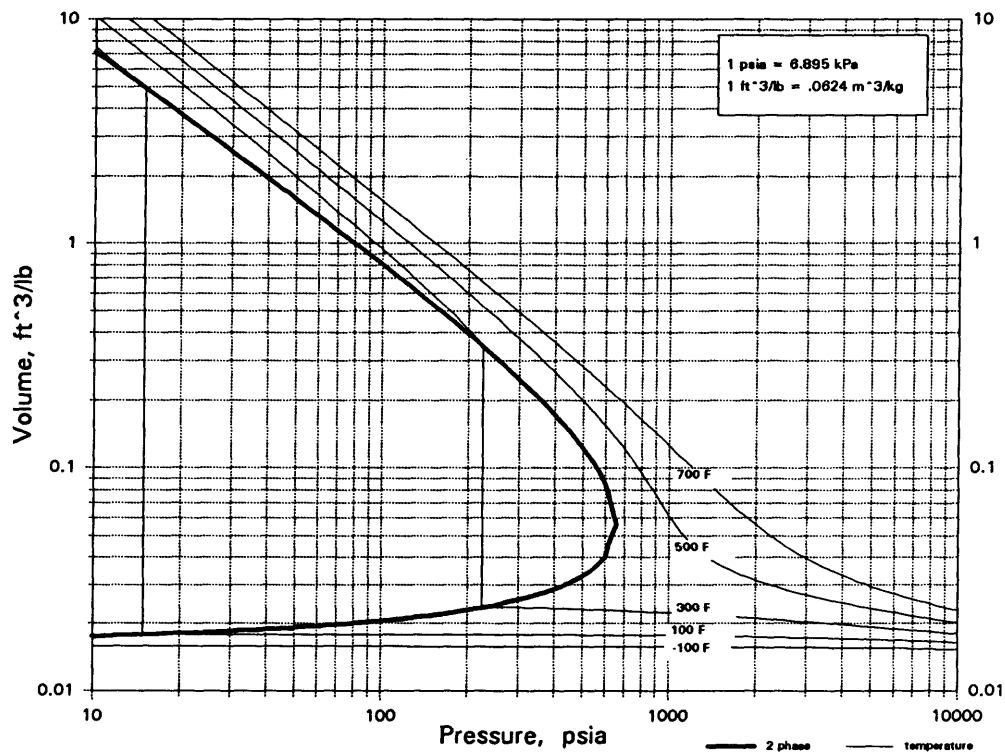
1-BROMOPROPANE



C3H7Br**2-BROMOPROPANE**

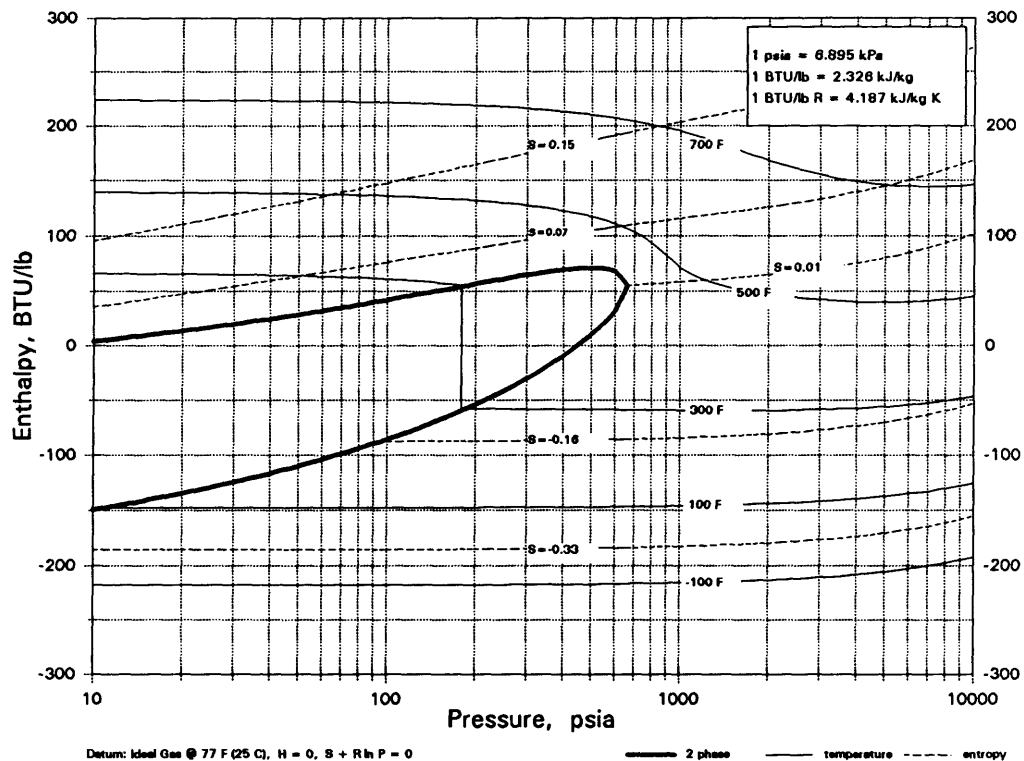
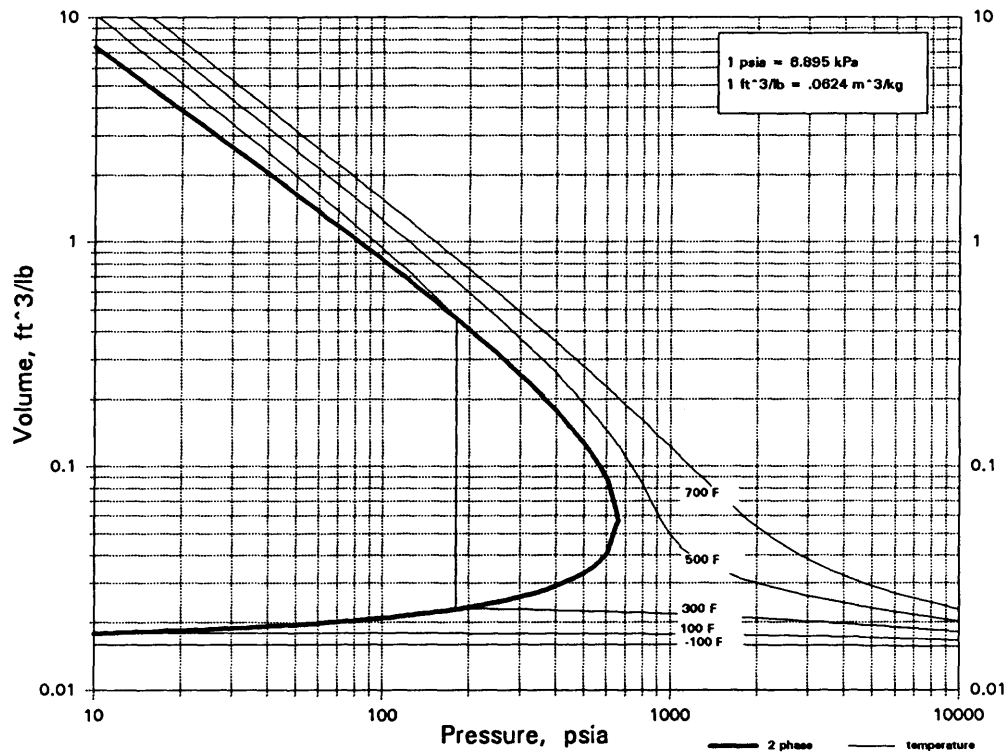
C3H7Cl

ISOPROPYL CHLORIDE

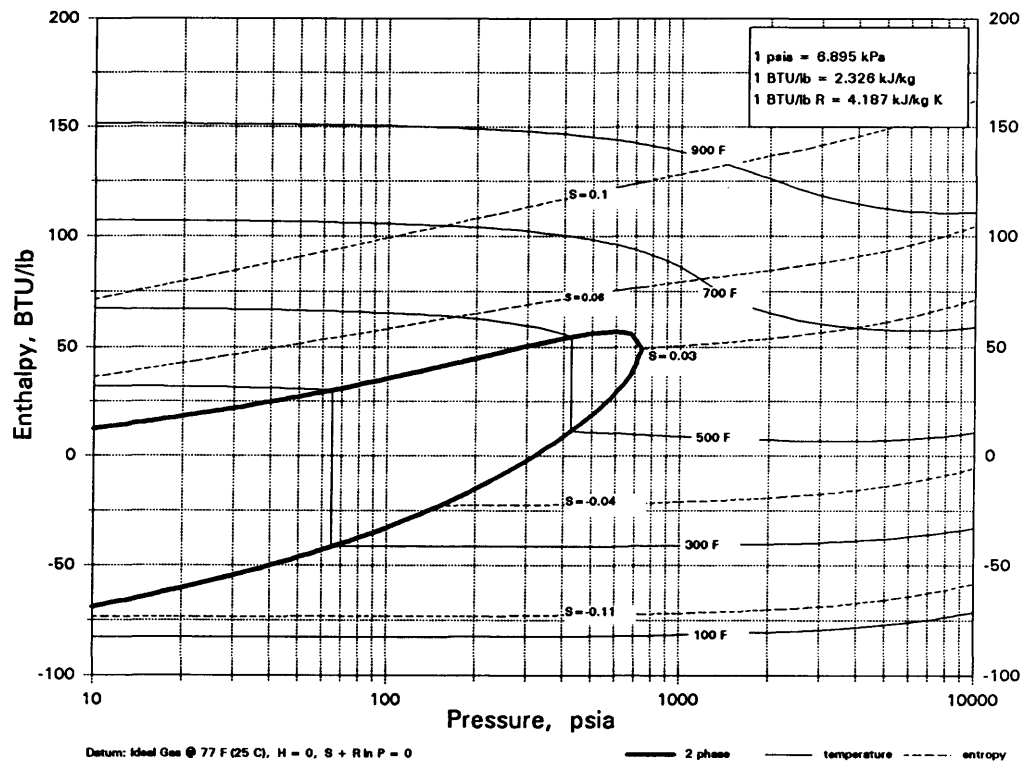
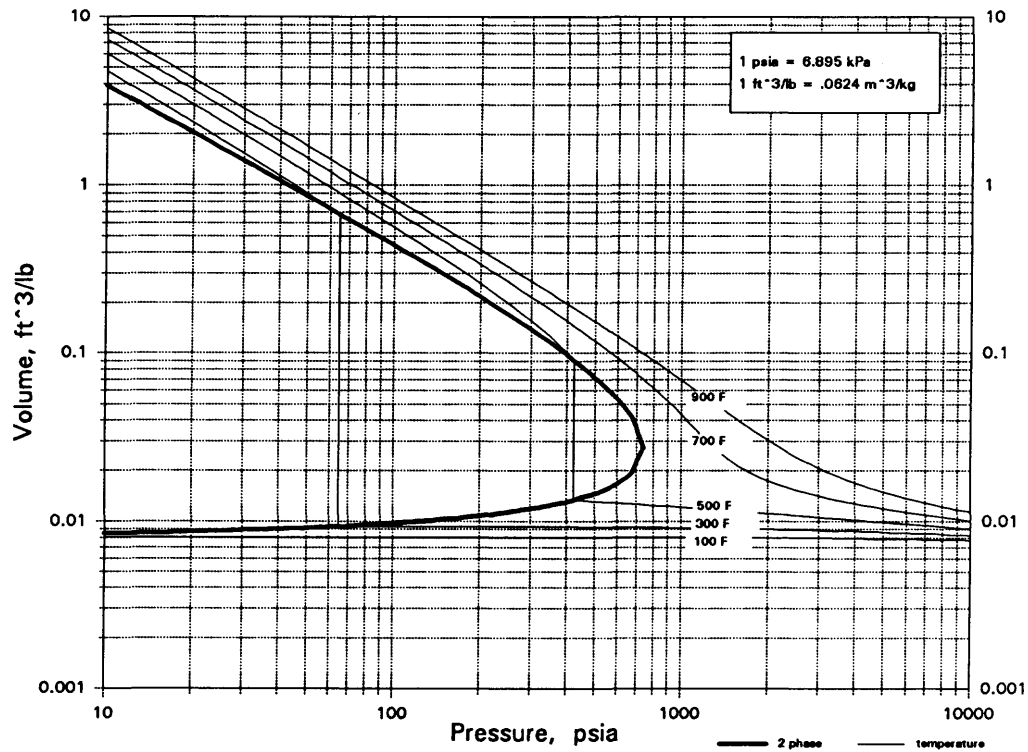


C3H7Cl

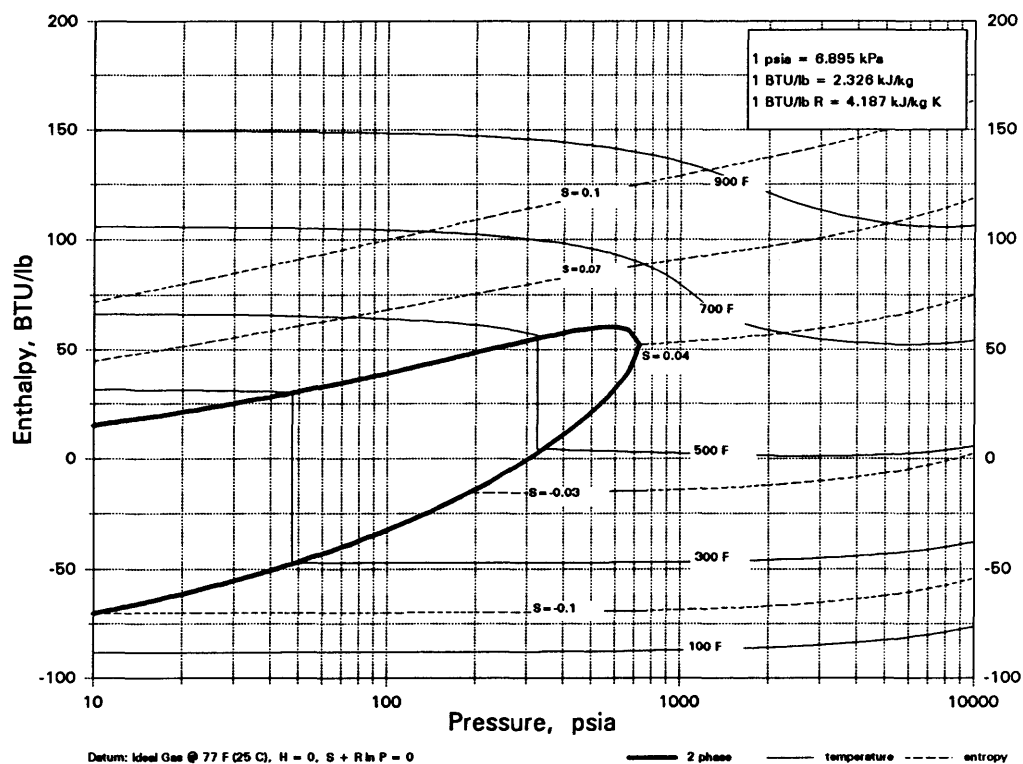
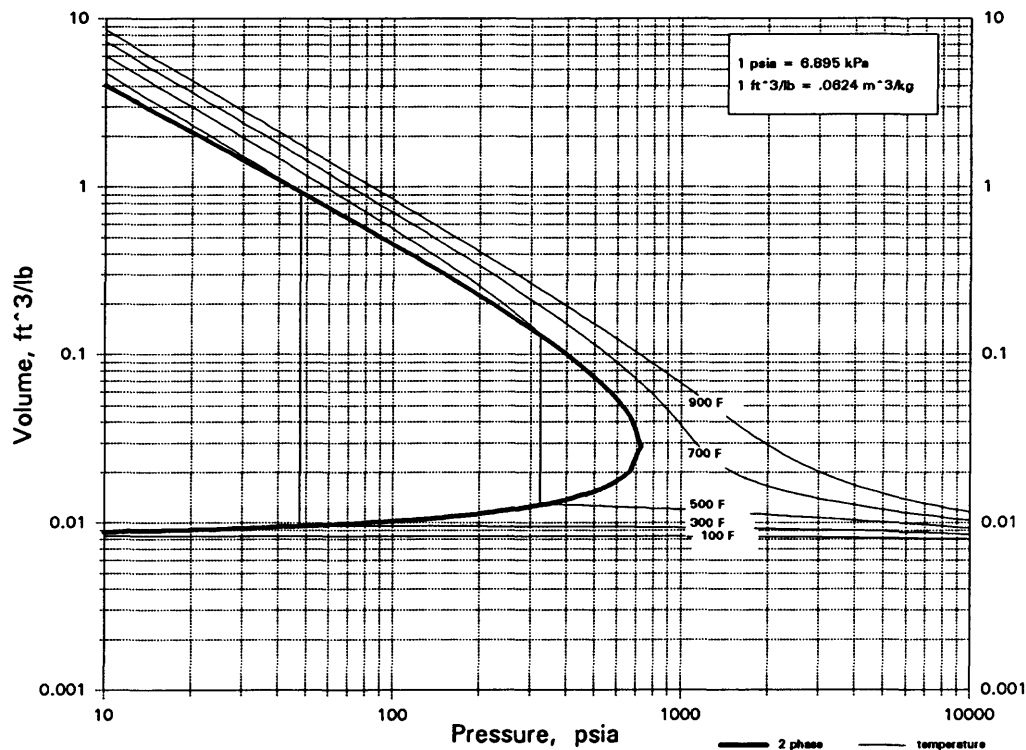
n-PROPYL CHLORIDE



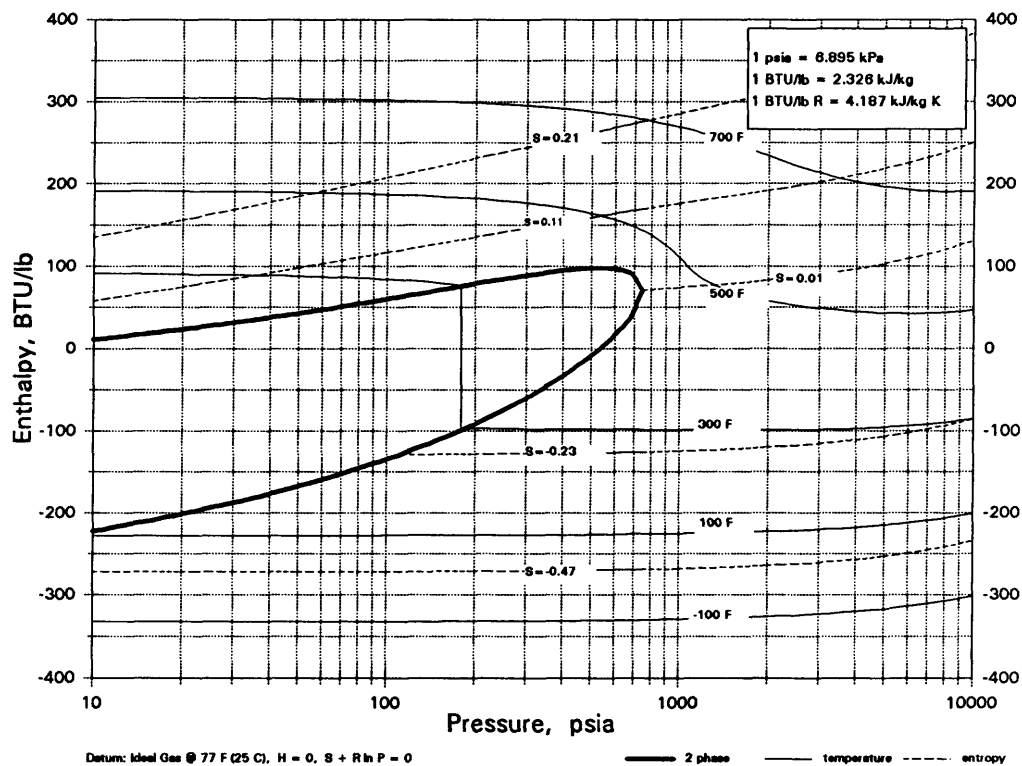
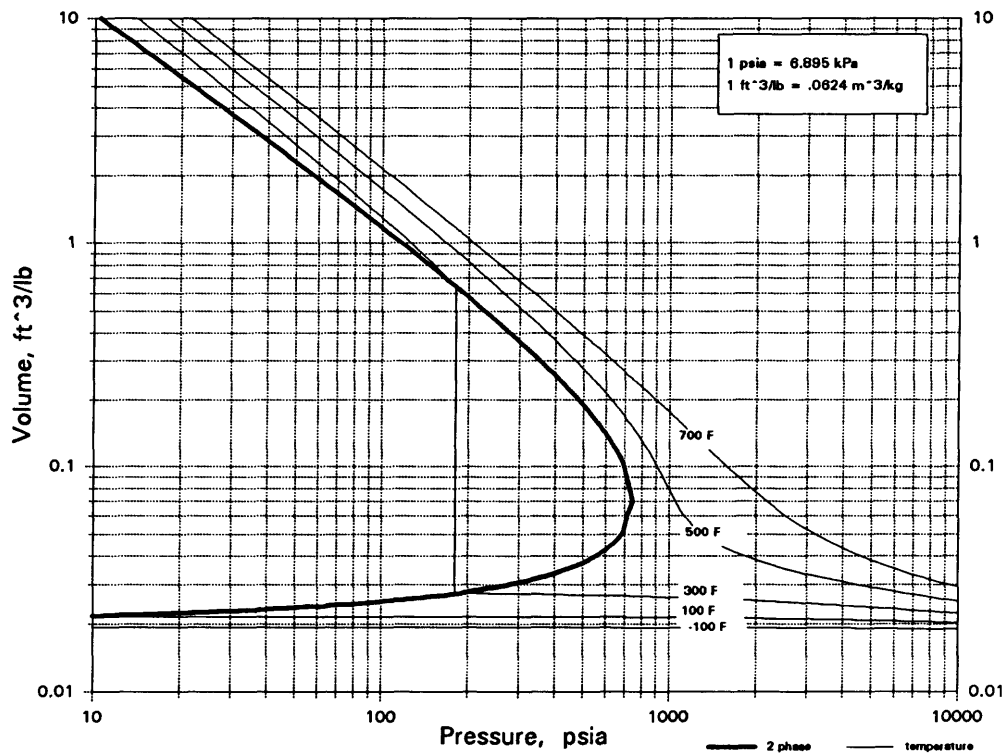
C3H7I
ISOPROPYL IODIDE



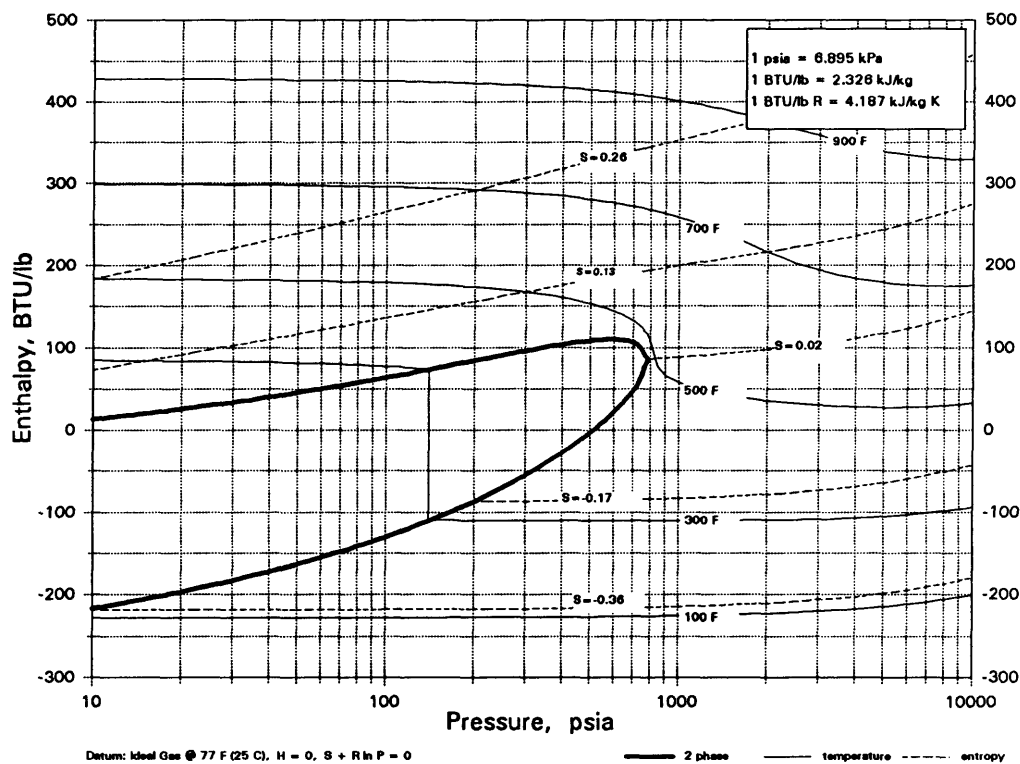
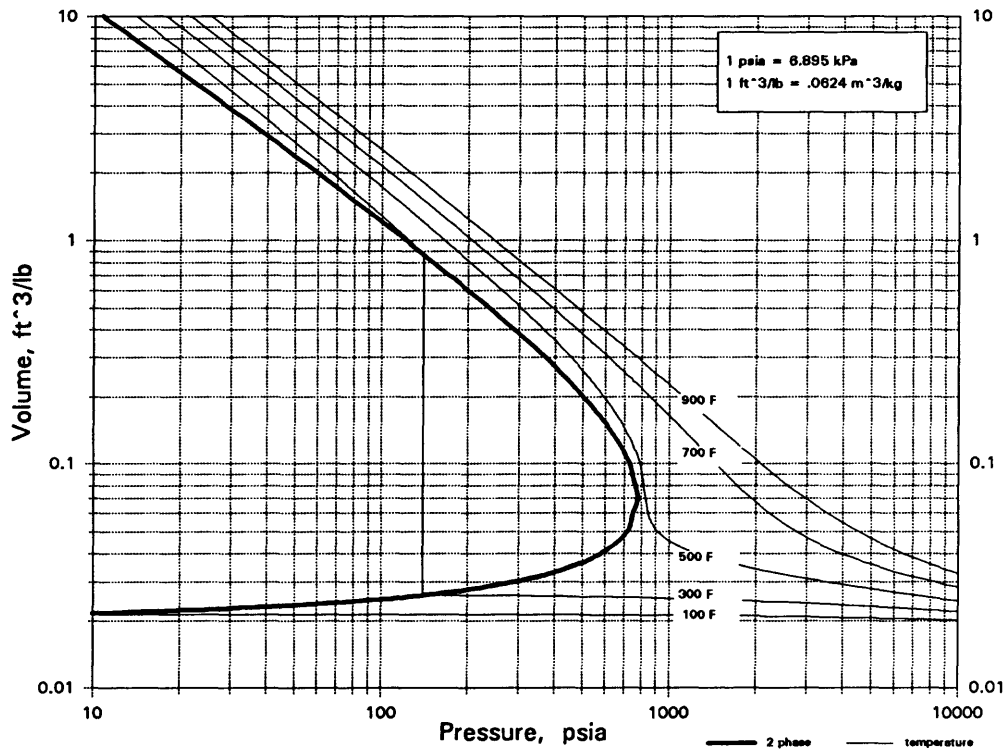
C3H7I
n-PROPYL IODIDE



C3H7N
ALLYLAMINE

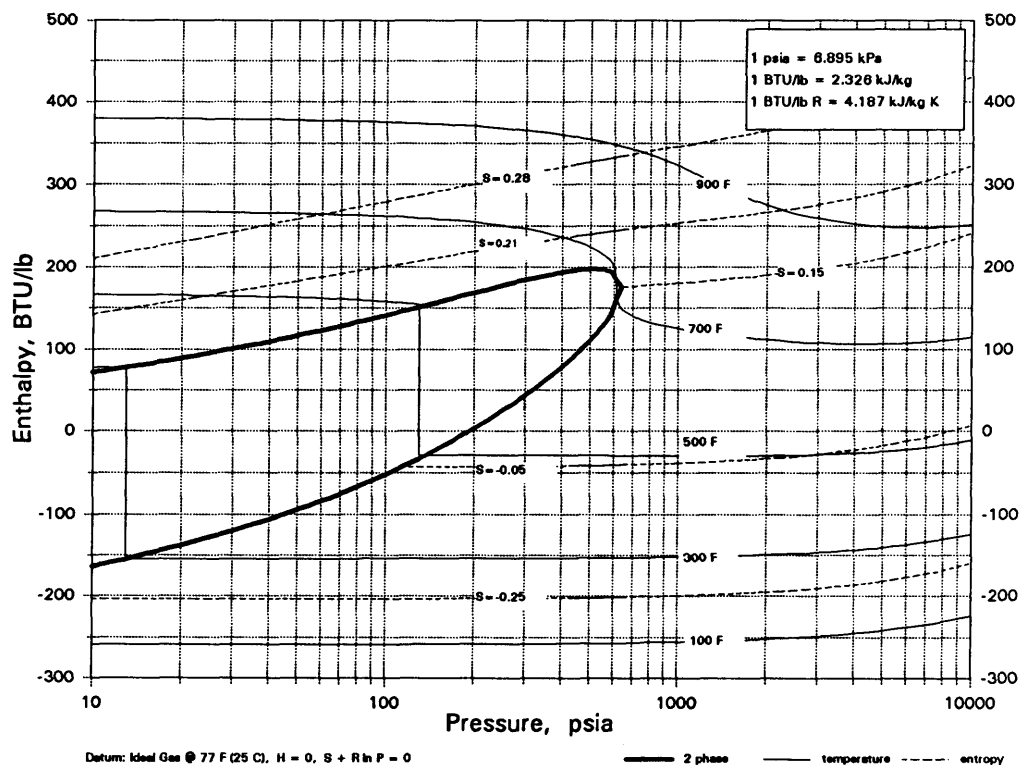
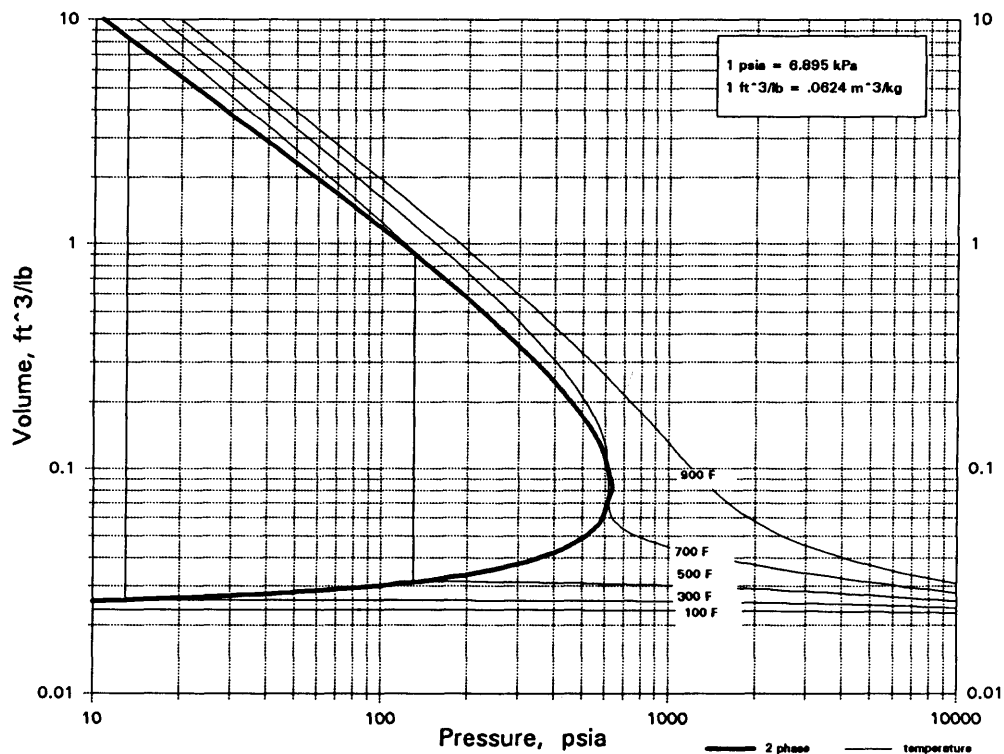


C3H7N
PROPYLENEIMINE



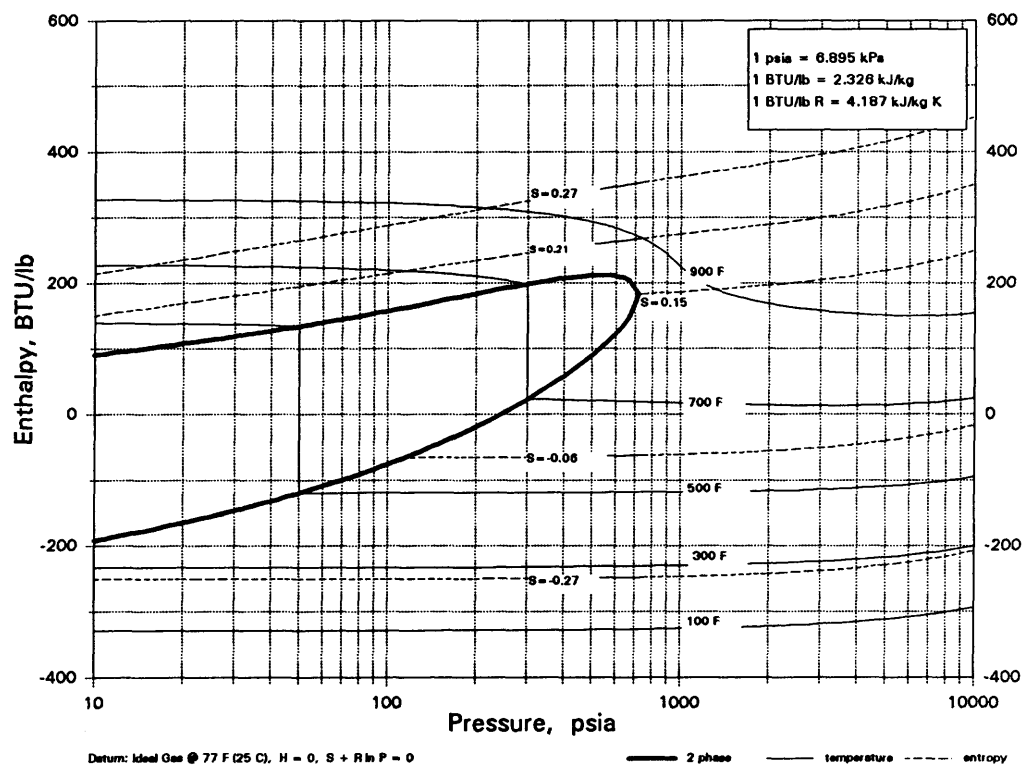
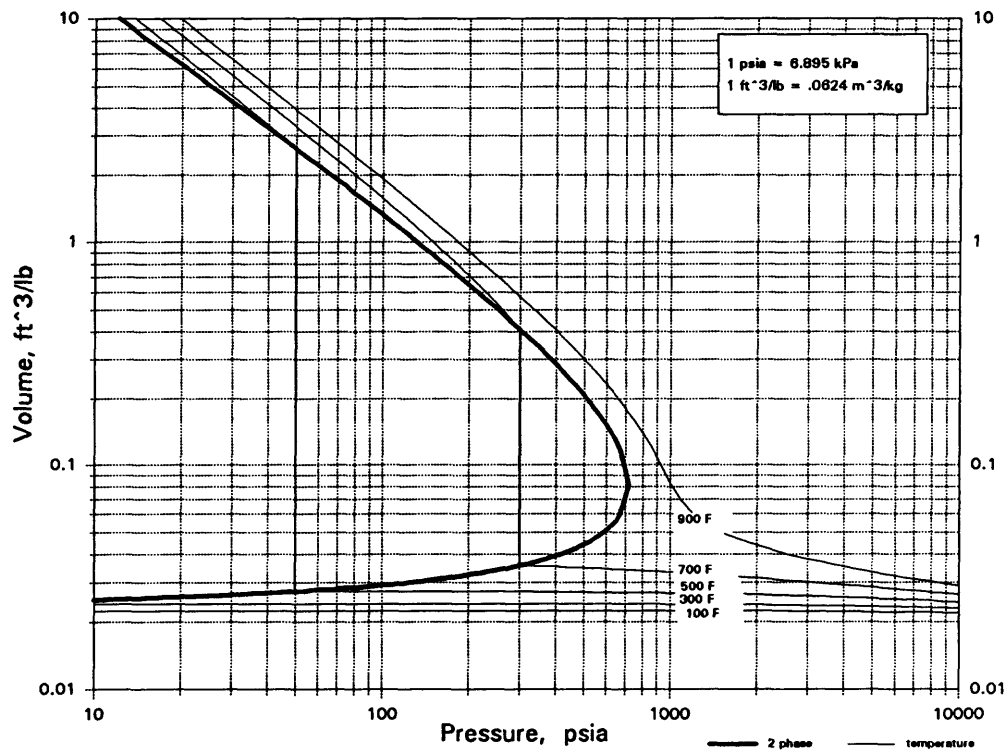
C3H7NO

N-N-DIMETHYLFORMAMIDE

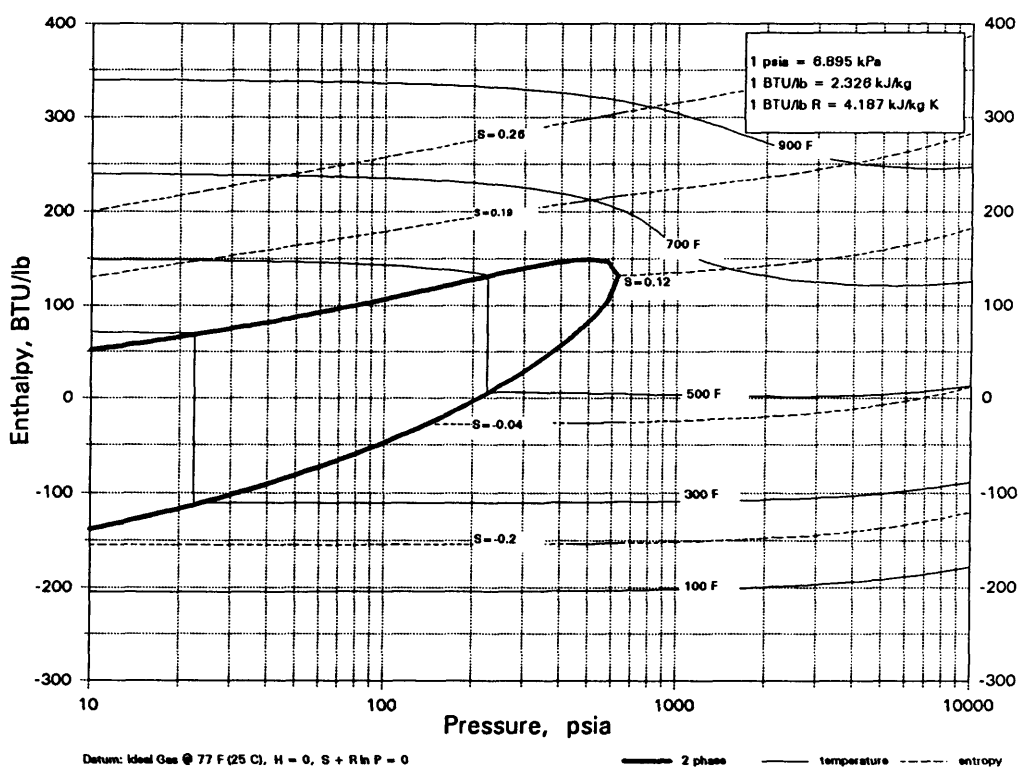
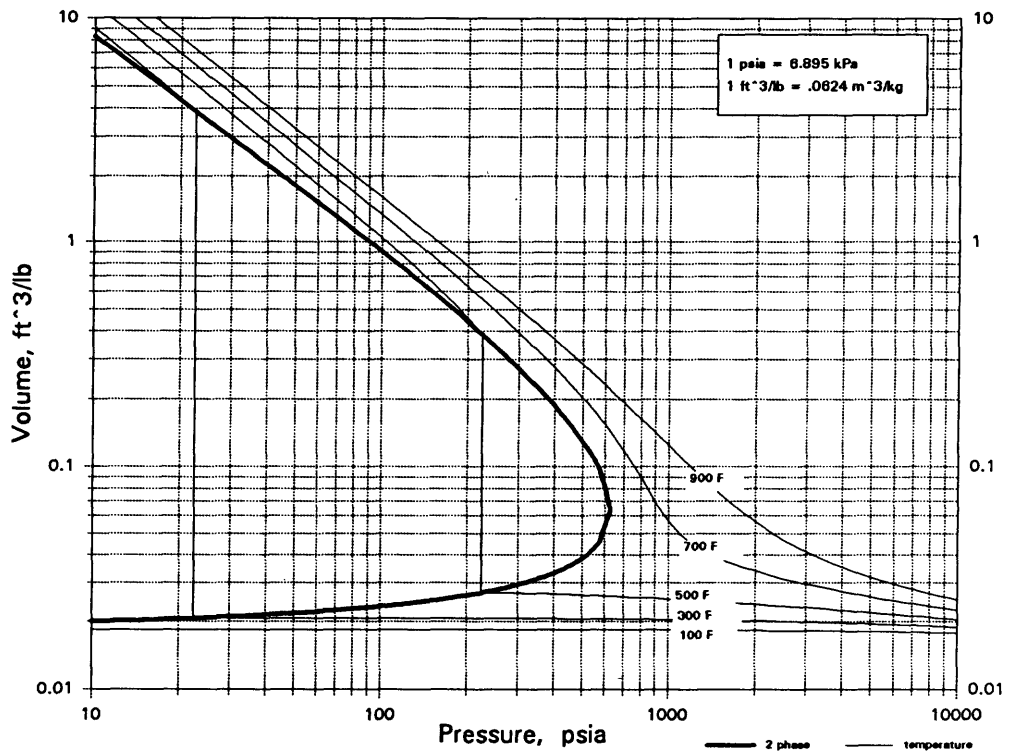


C3H7NO

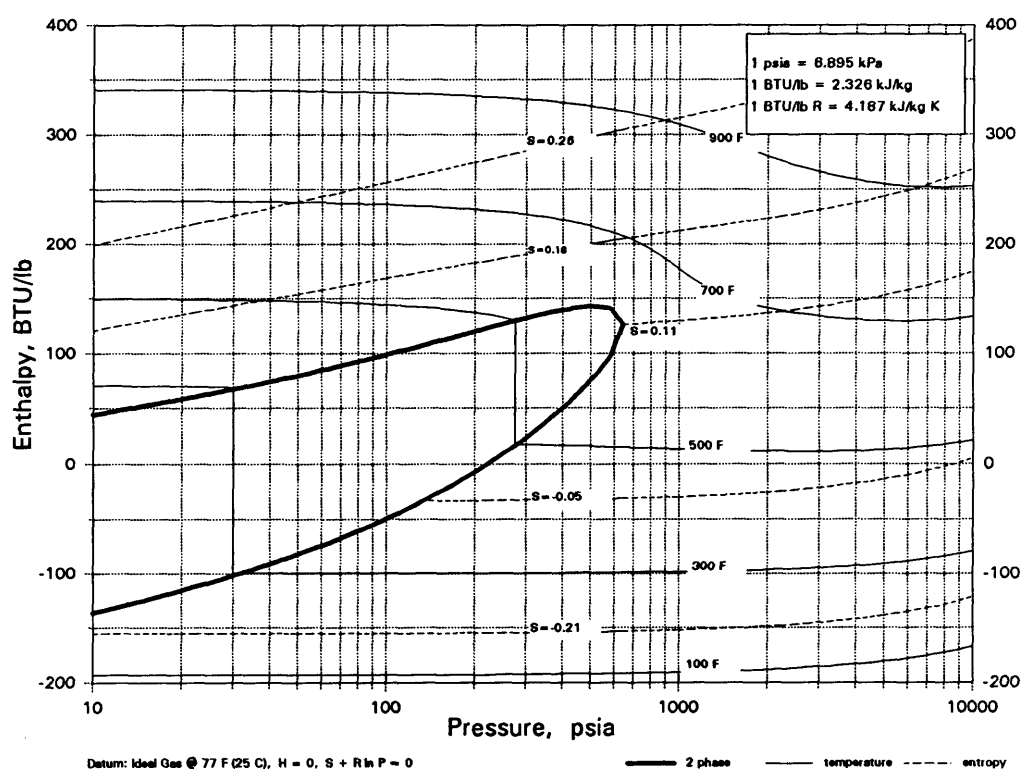
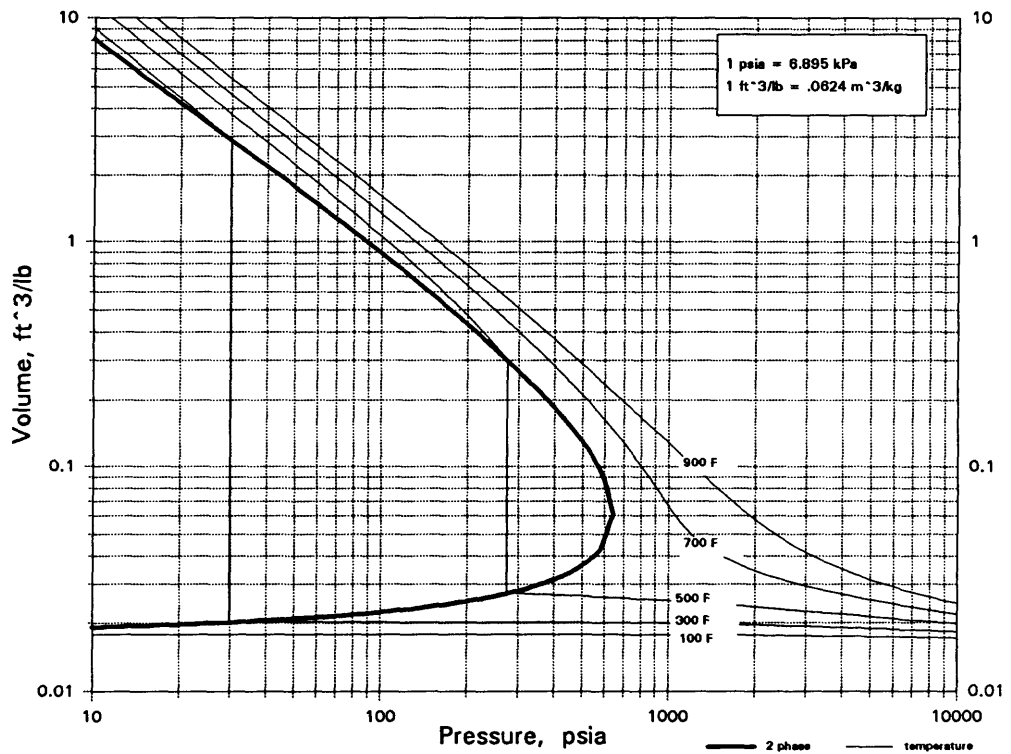
N-METHYLACETAMIDE



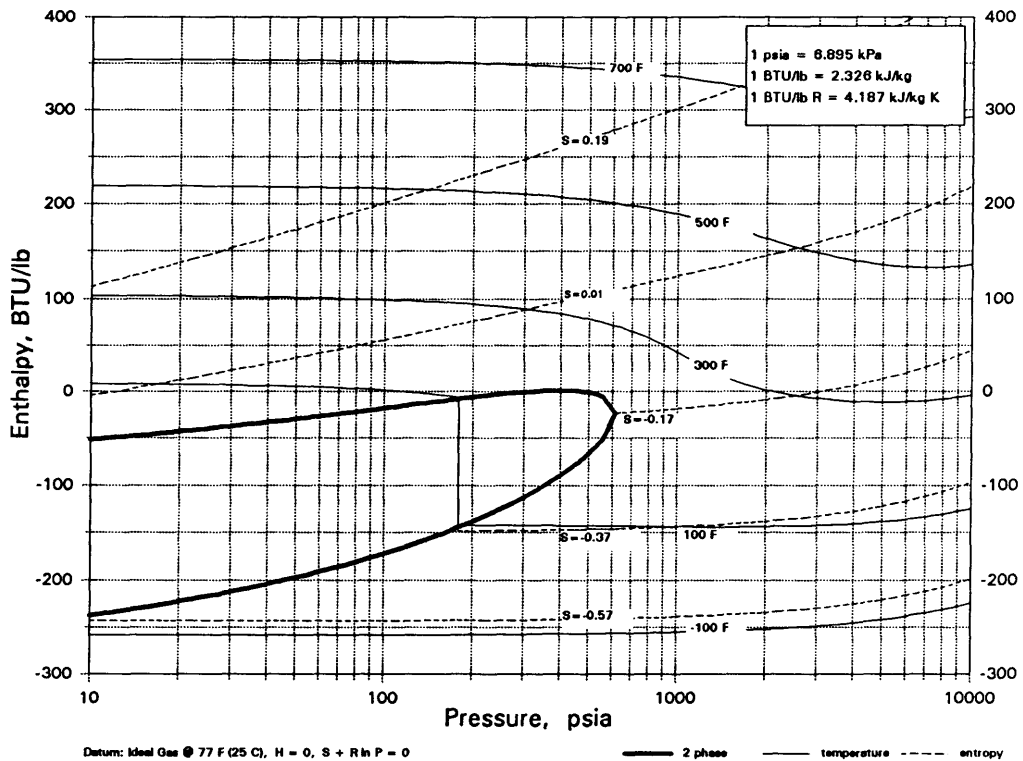
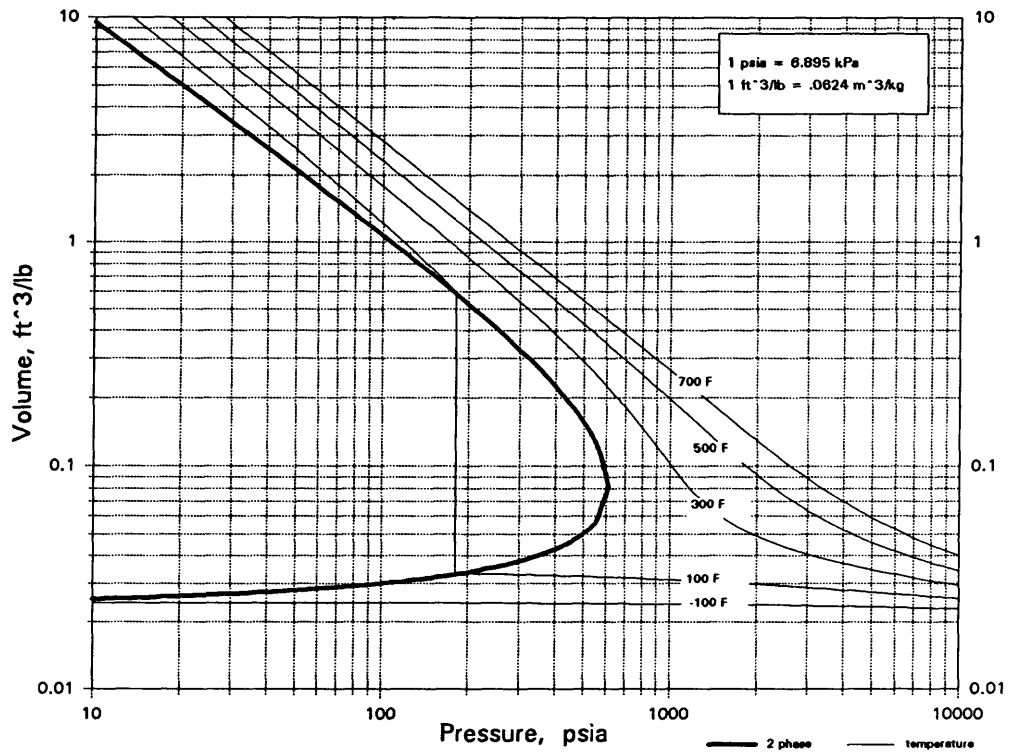
C3H7NO2
1-NITROPROPANE



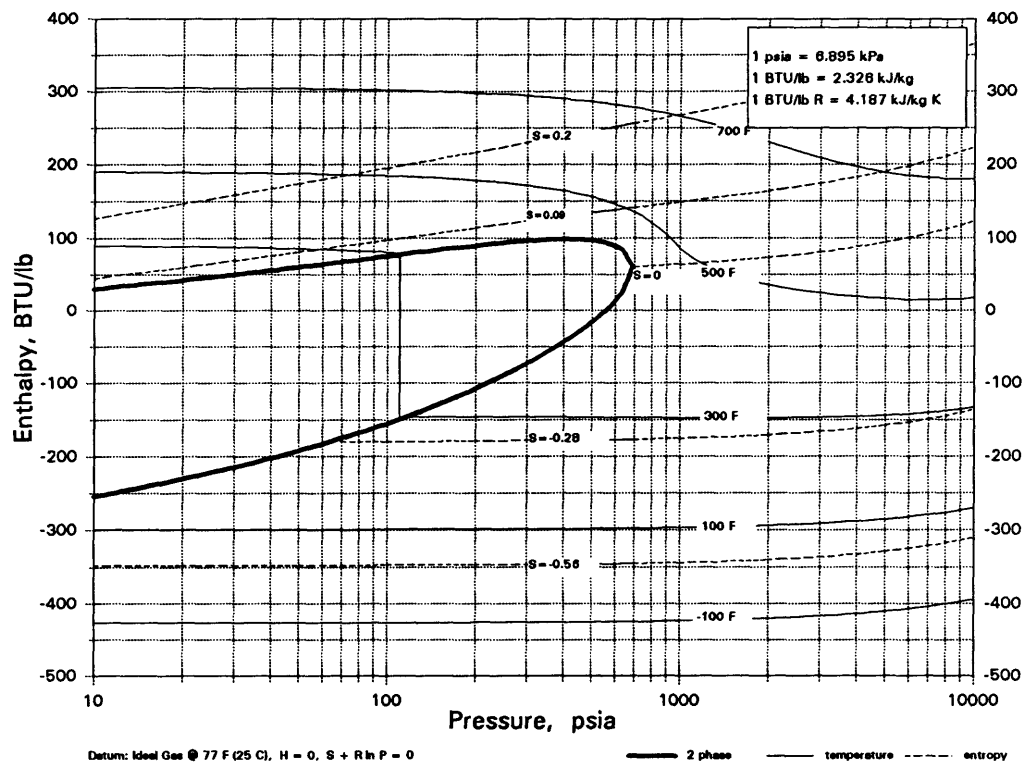
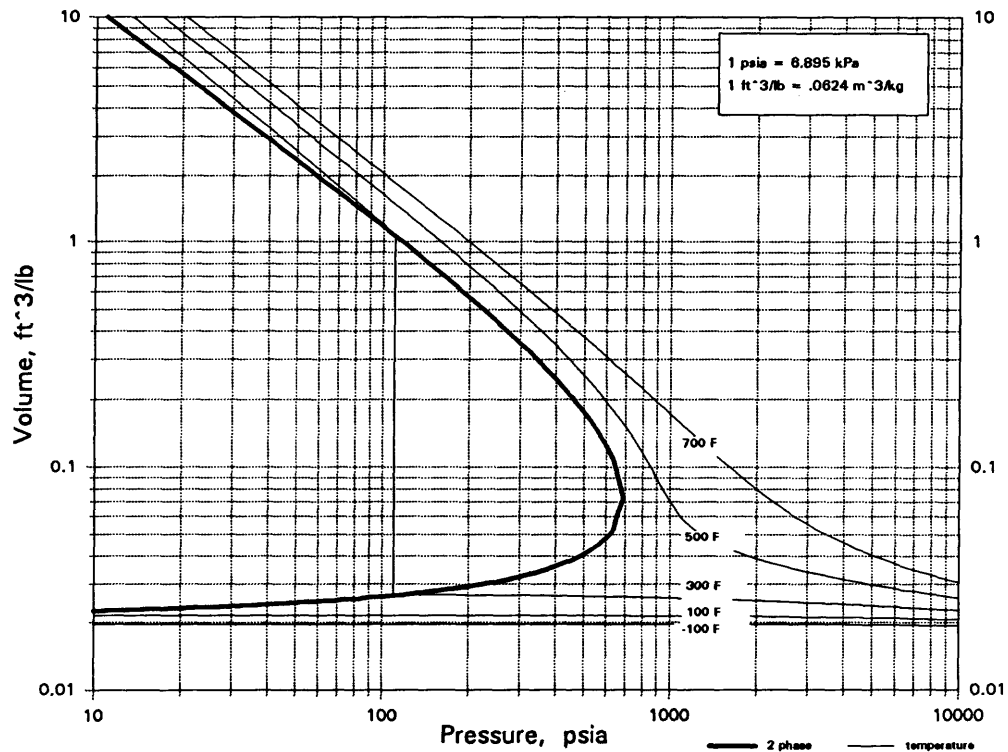
C3H7NO2
2-NITROPROPANE



C3H8
PROPANE

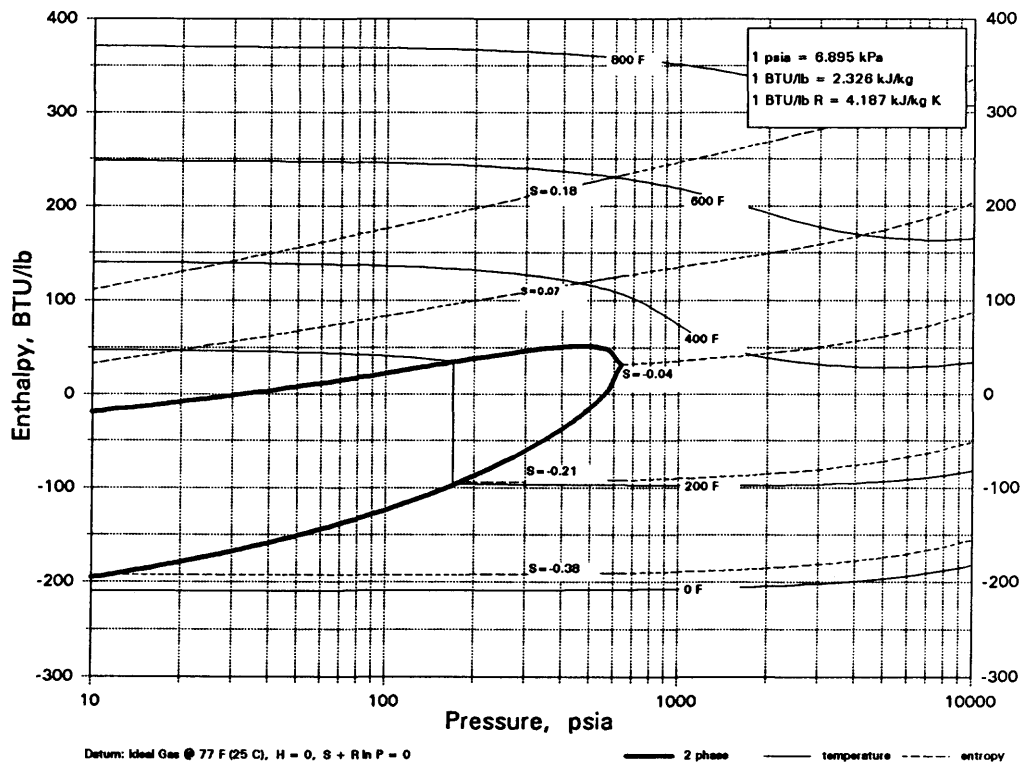
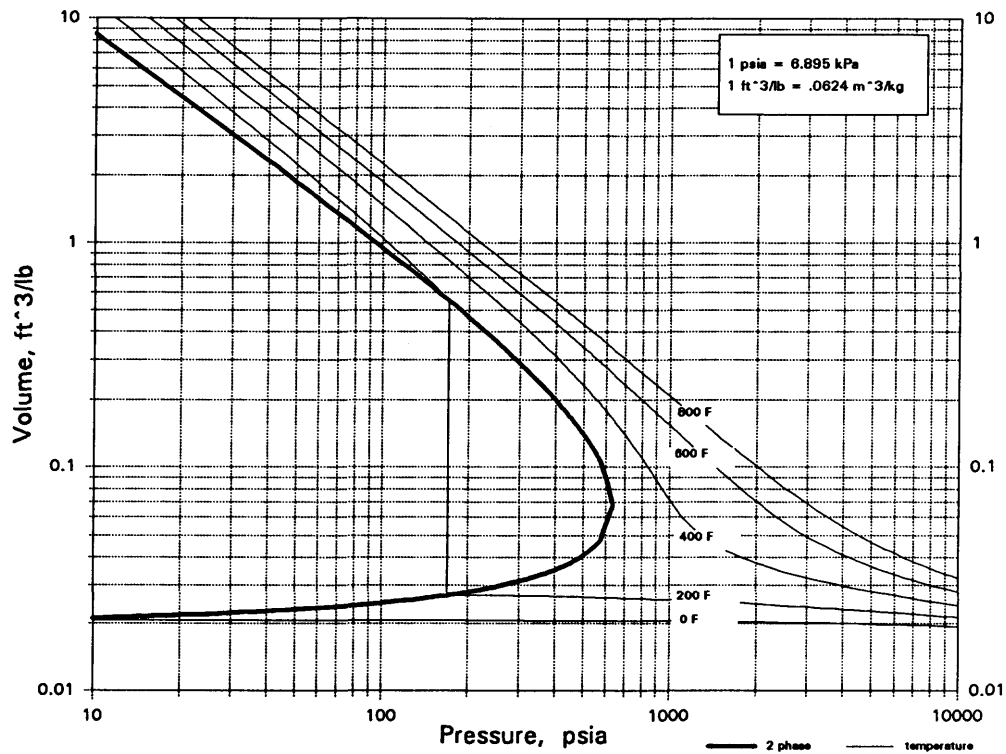


C3H8O
ISOPROPANOL



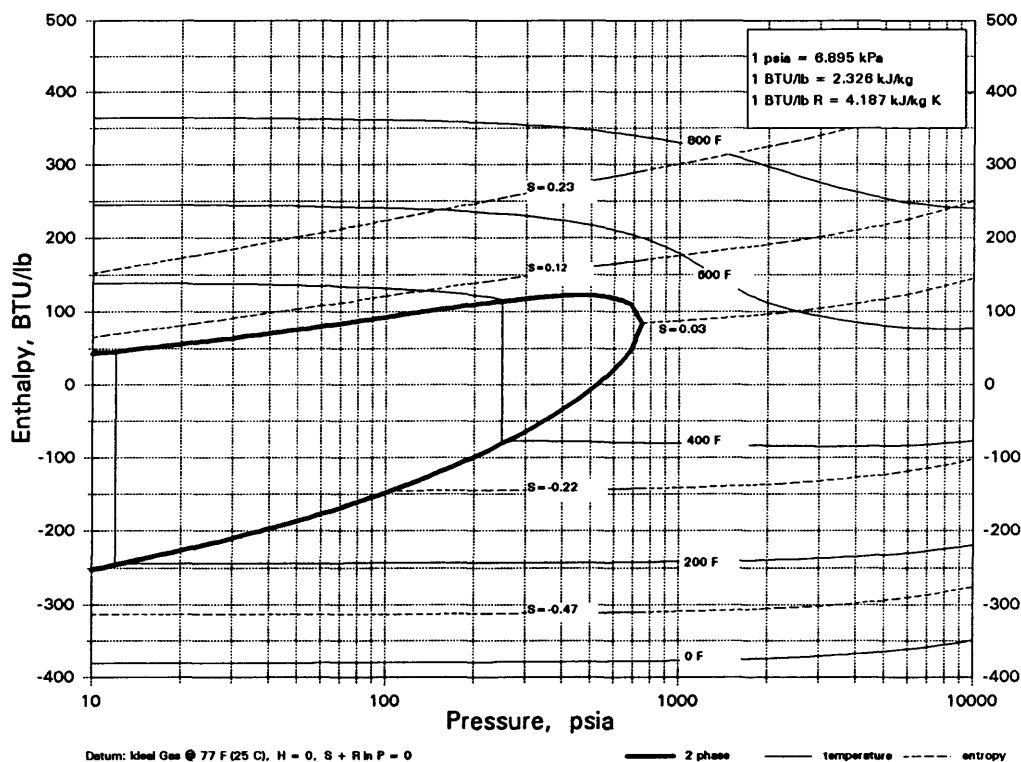
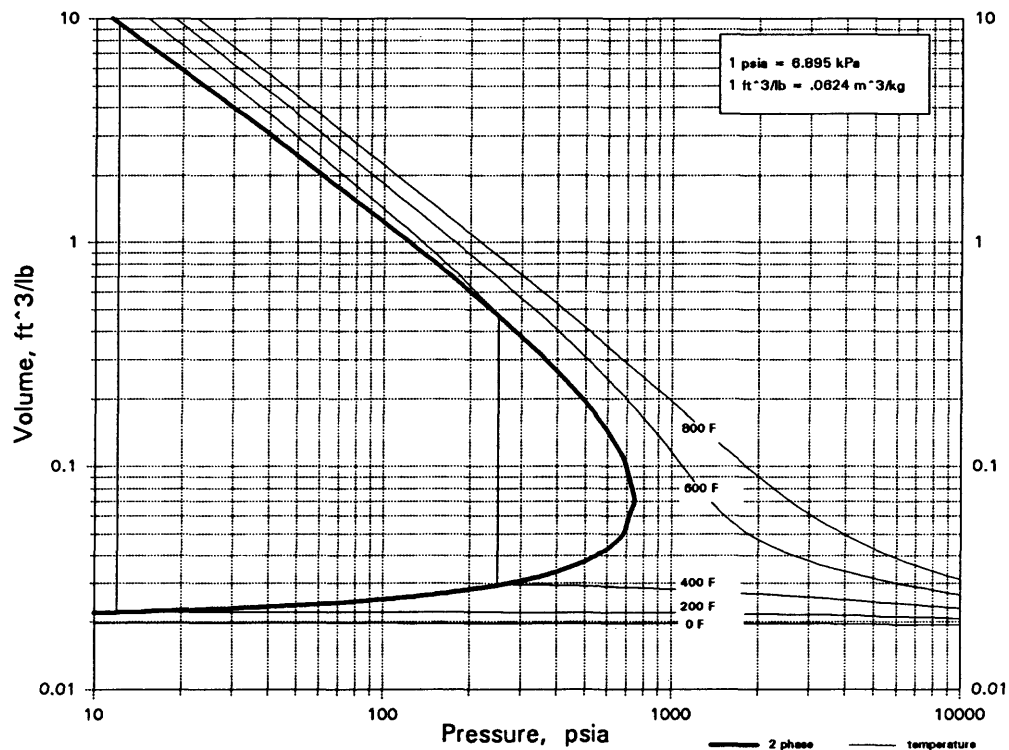
C3H8O

METHYL ETHYL ETHER



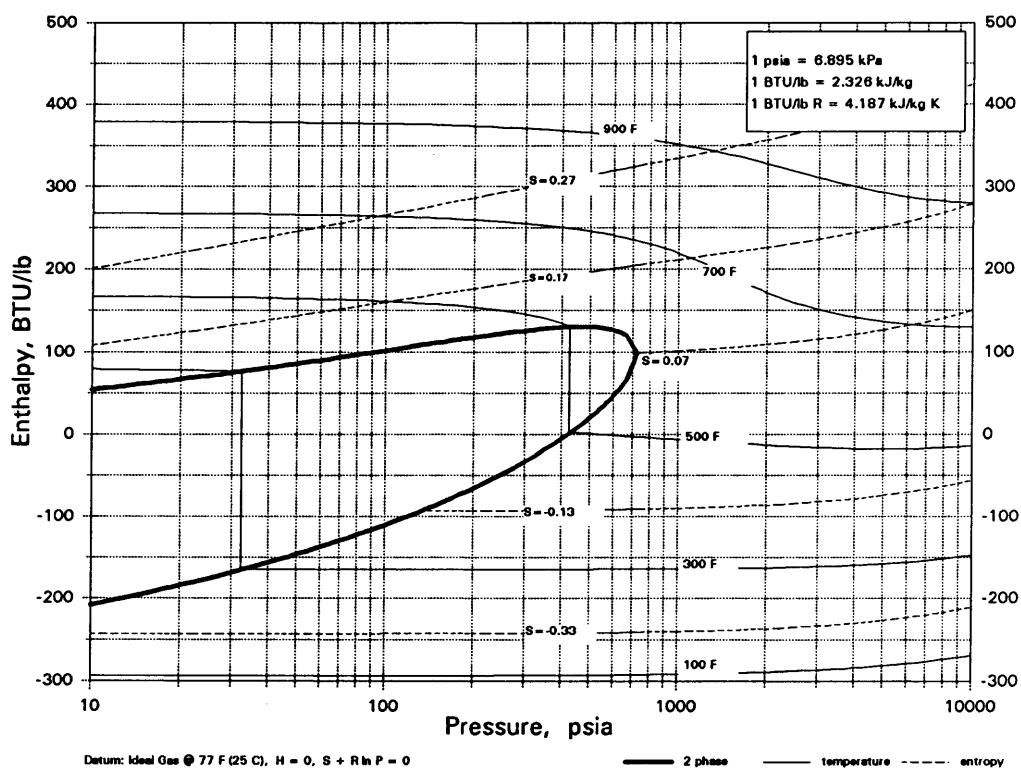
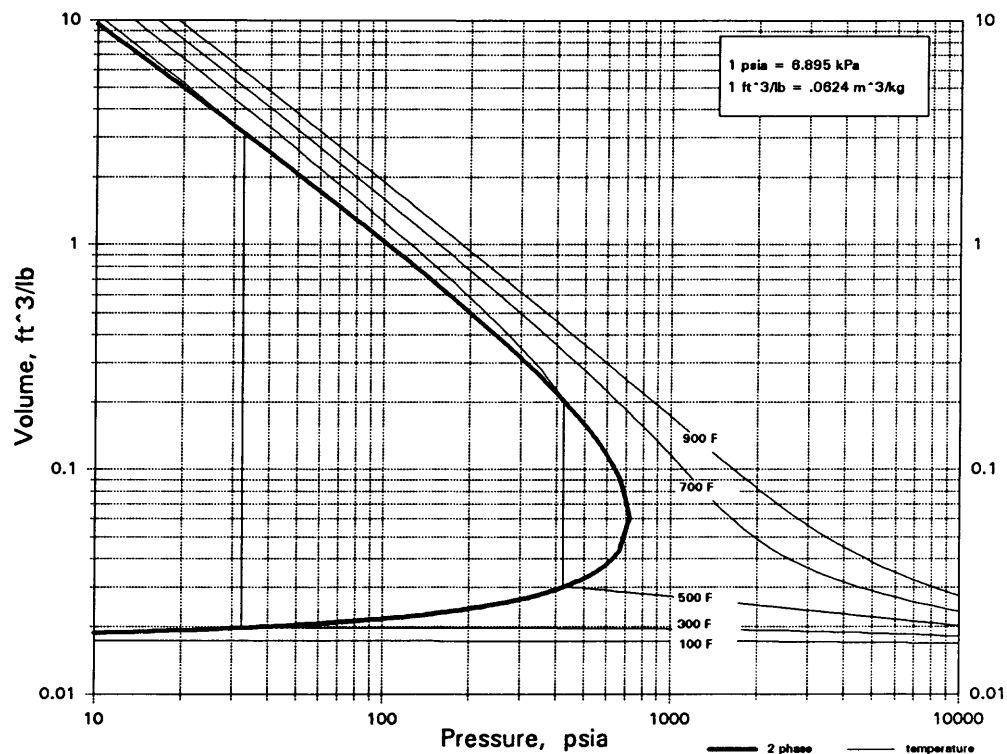
C3H8O

n-PROPANOL

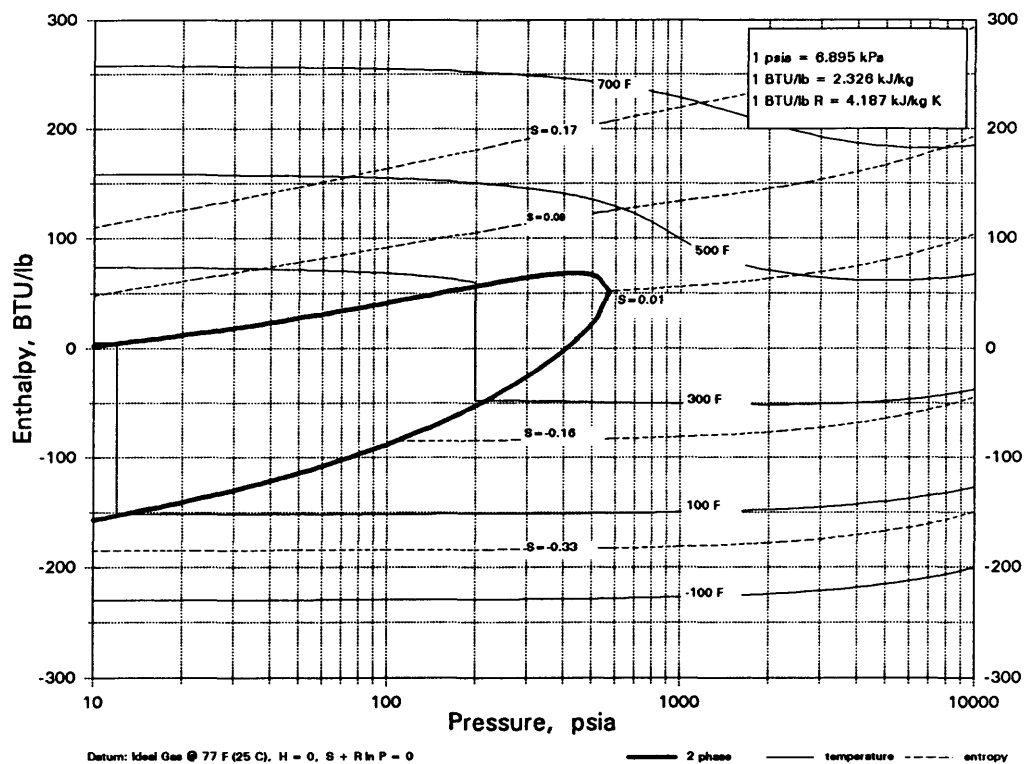
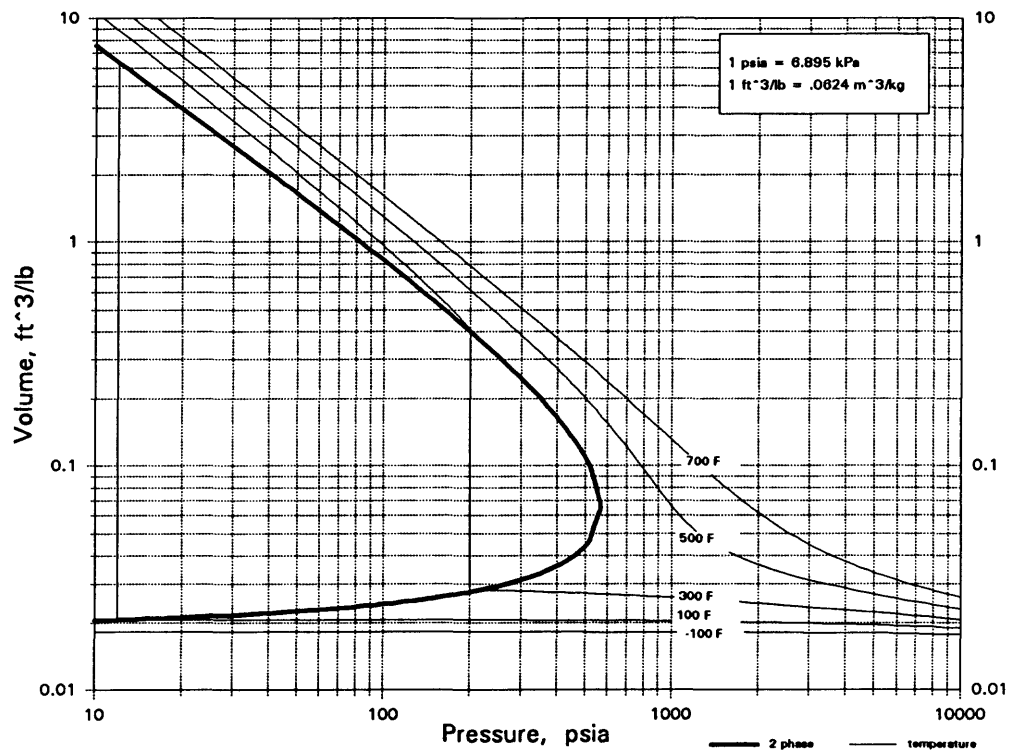


C3H8O2

2-METHOXYETHANOL

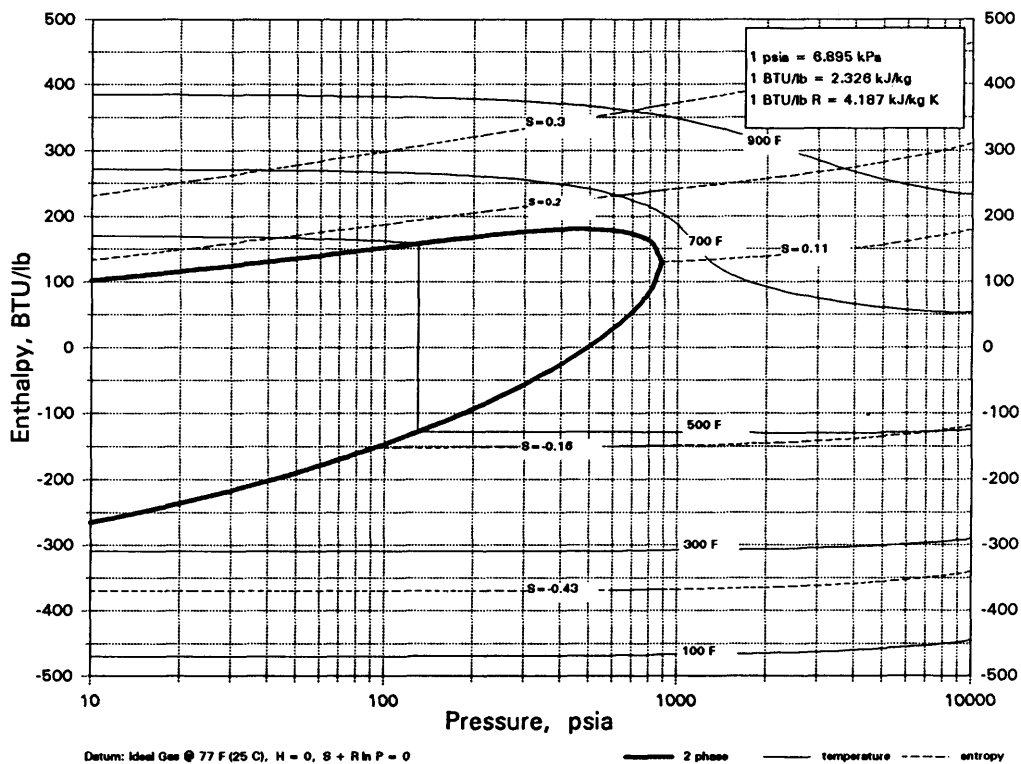
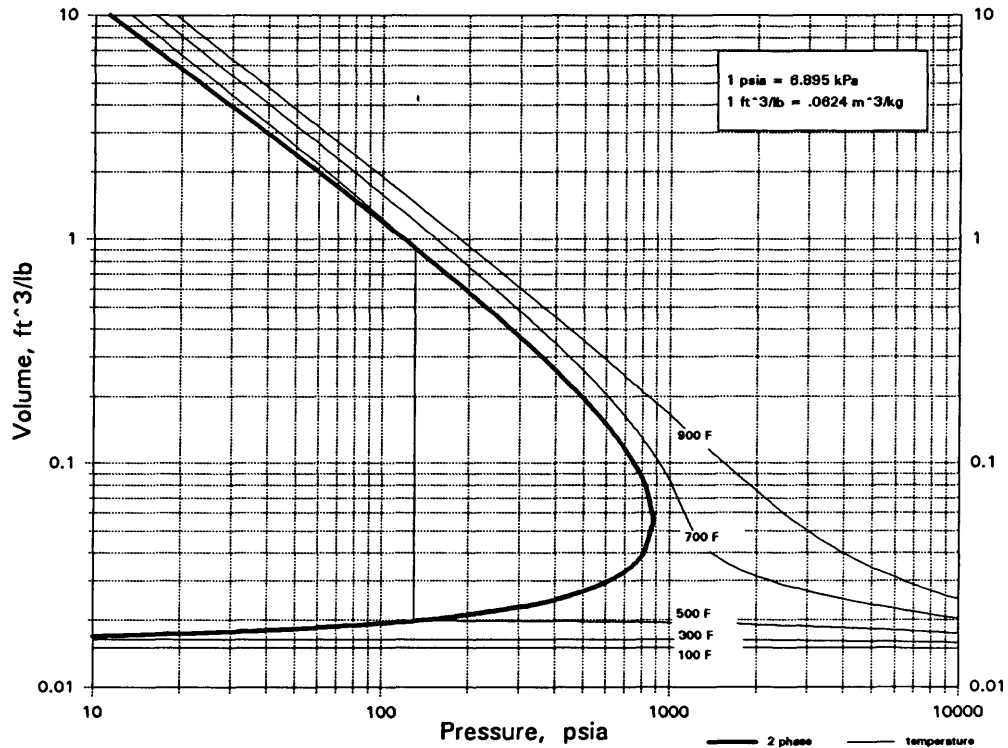


C3H8O2
METHYLAL



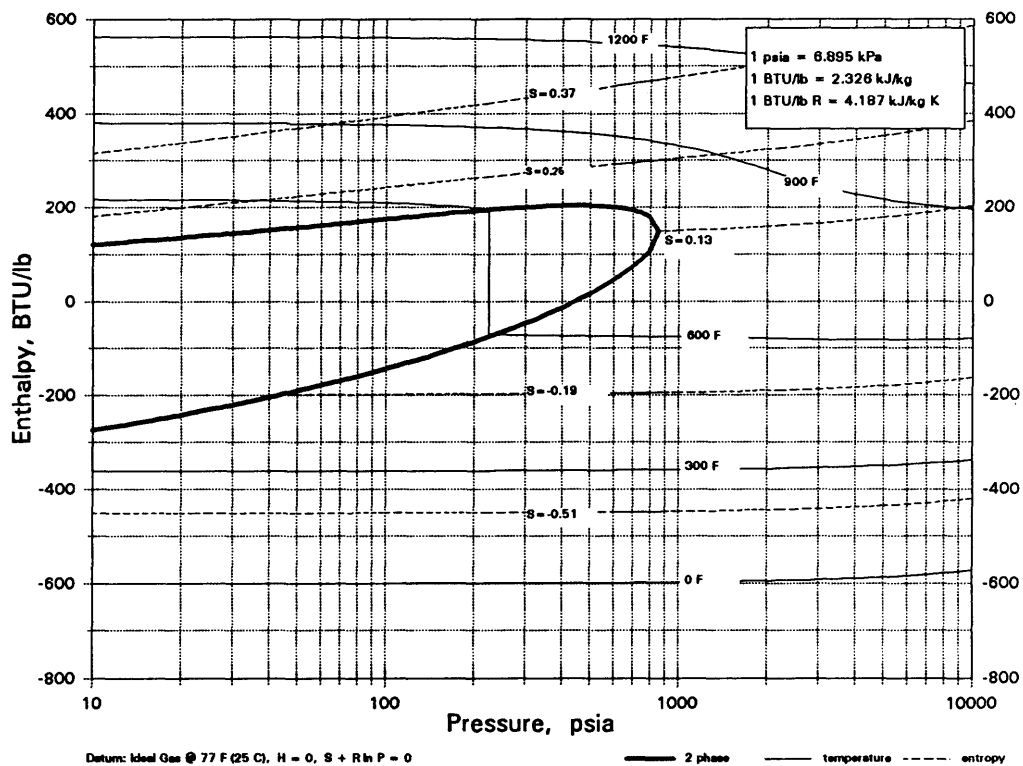
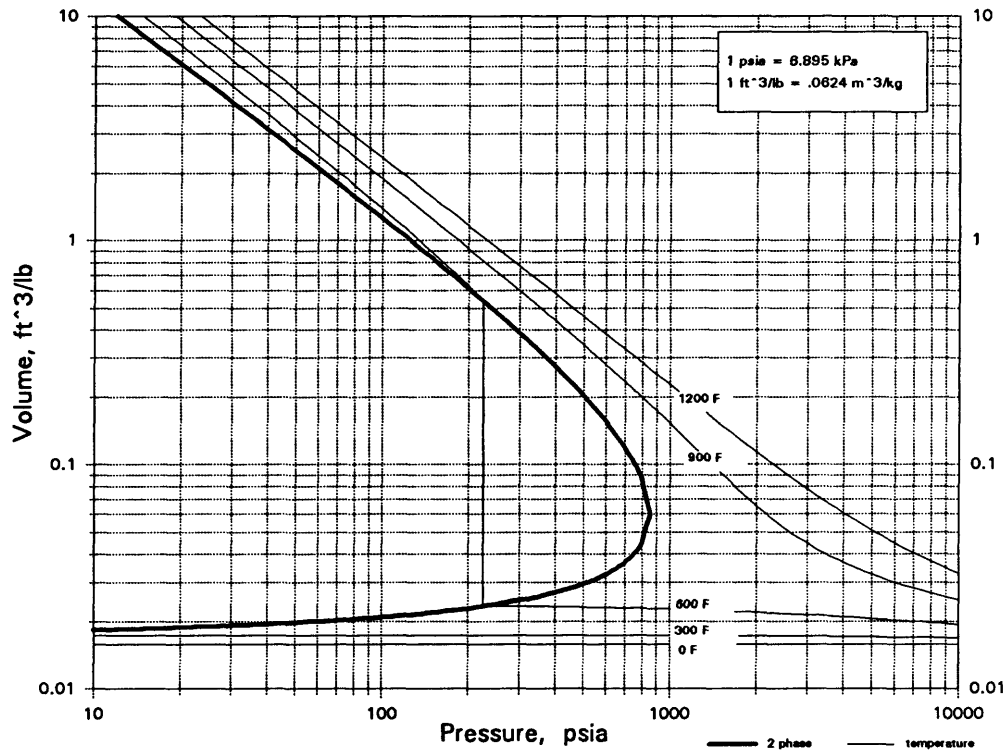
C3H8O2

1-2-PROPYLENE GLYCOL



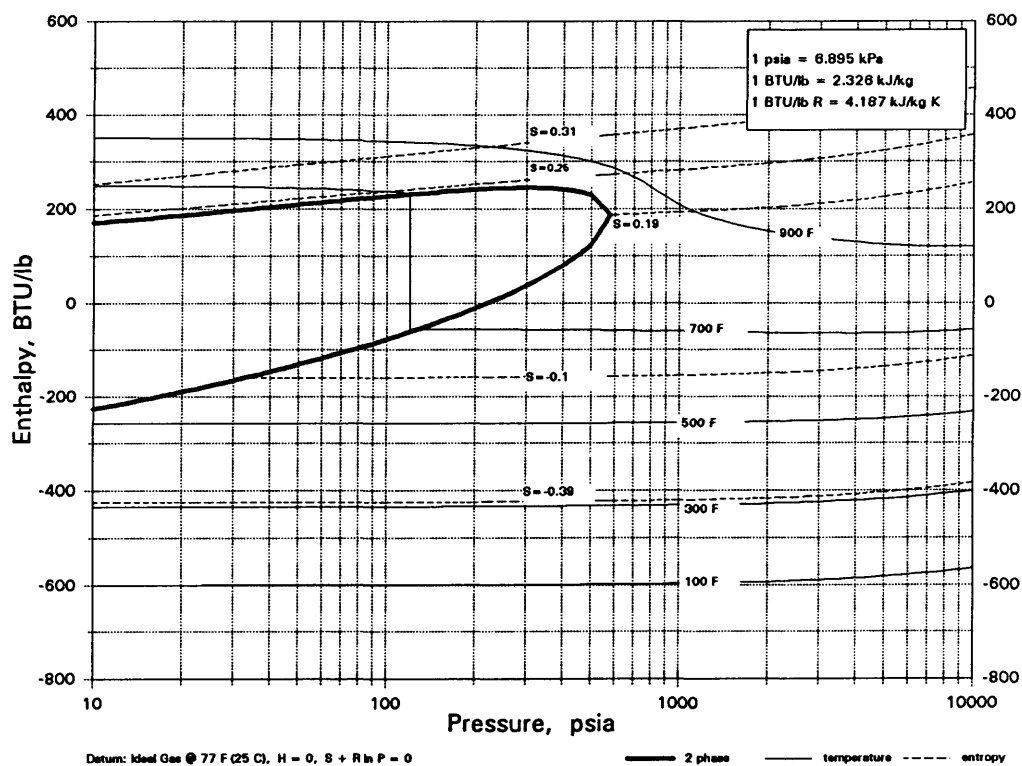
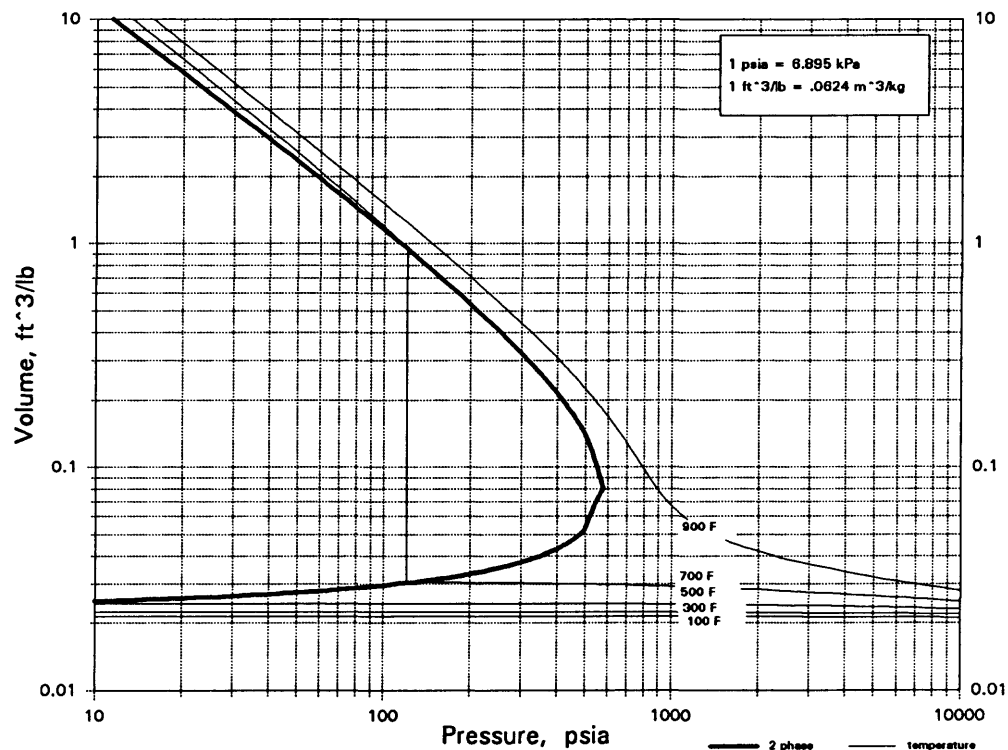
C3H8O2

1-3-PROPYLENE GLYCOL

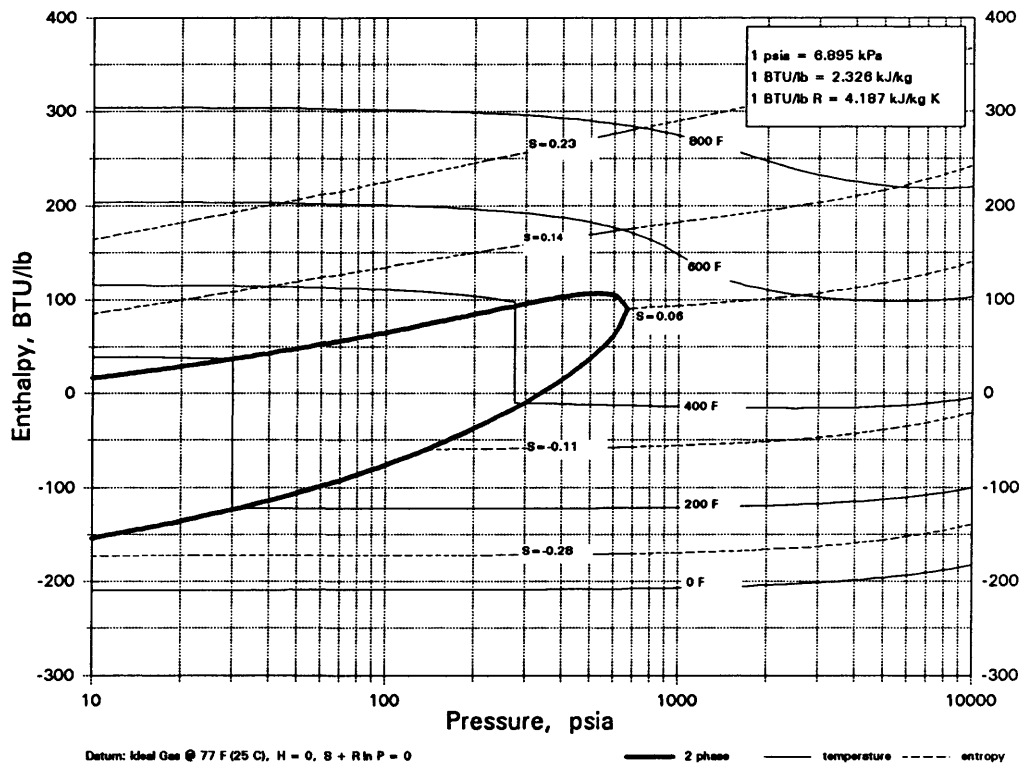
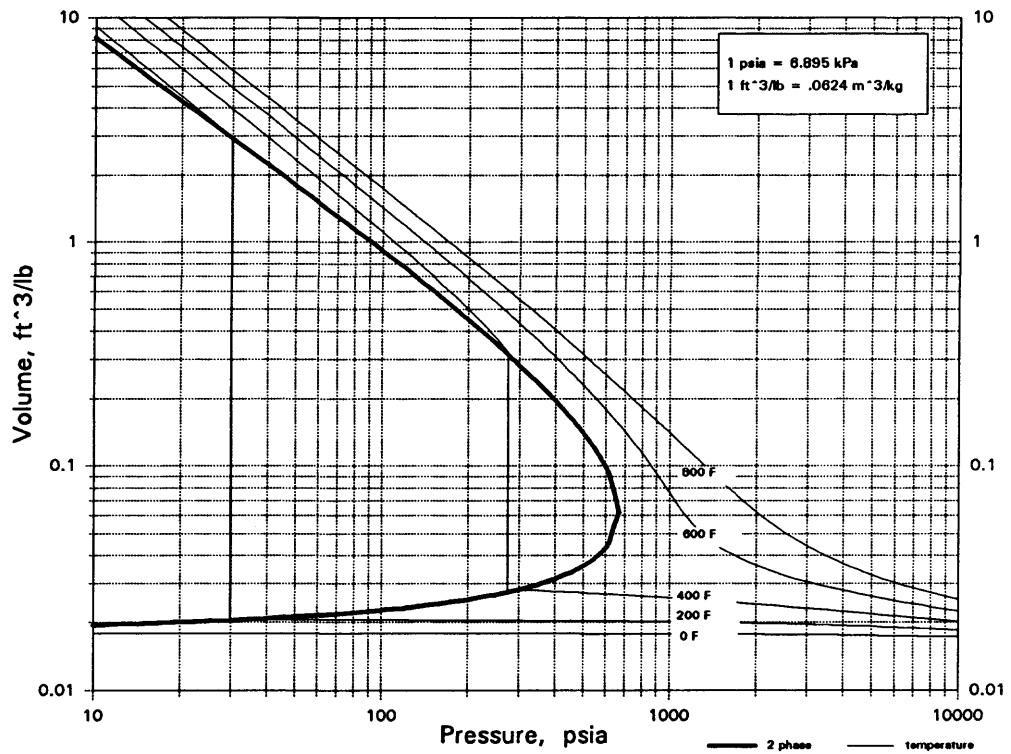


C3H8O3

GLYCEROL

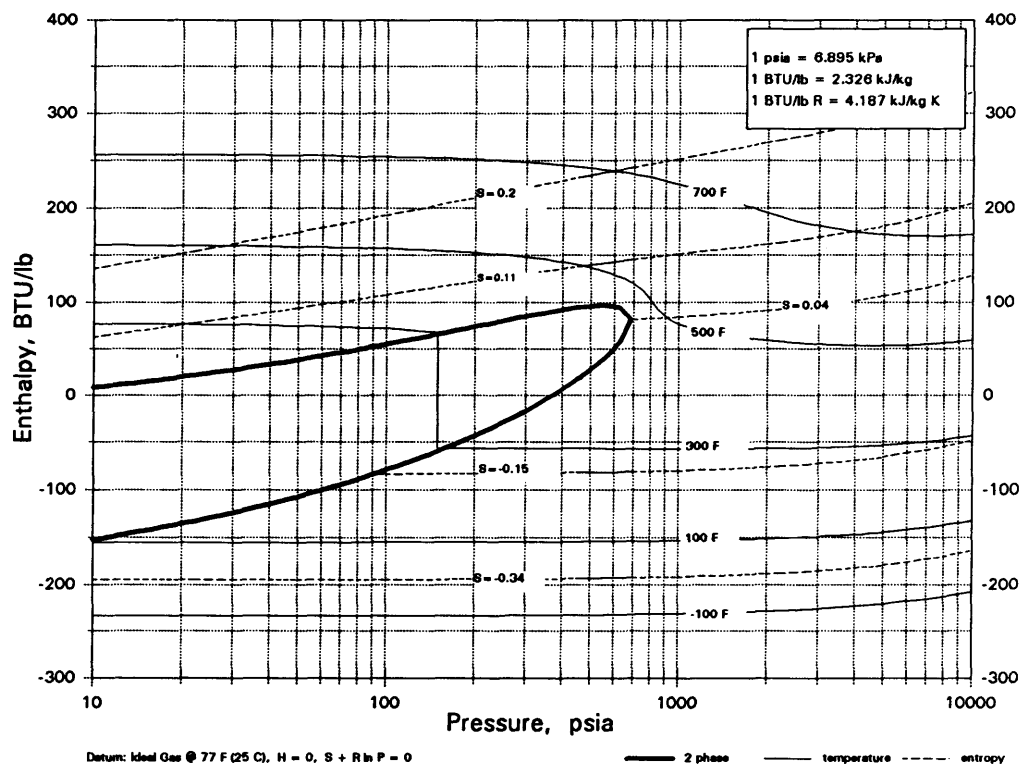
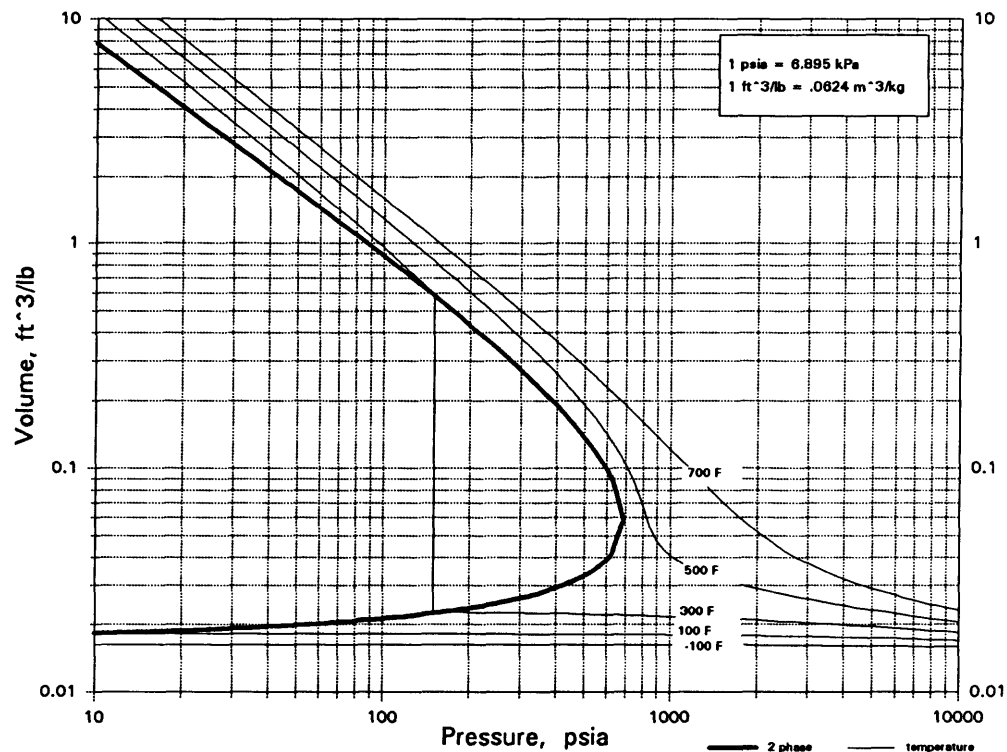


C3H8S
n-PROPYLMERCAPTAN

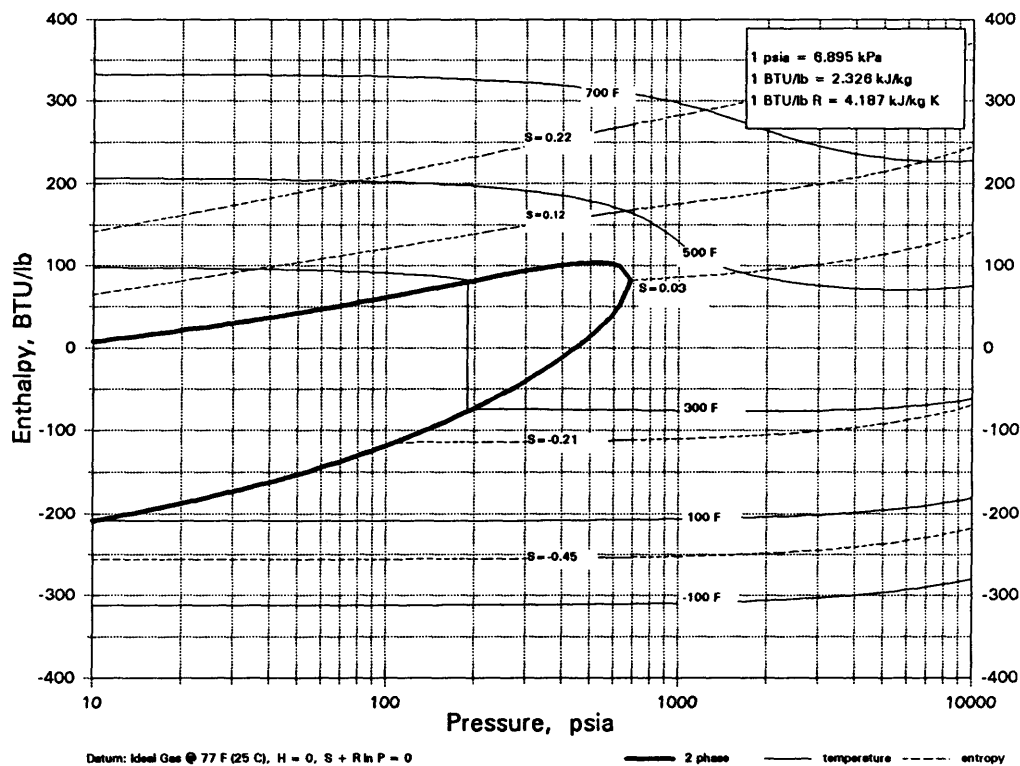
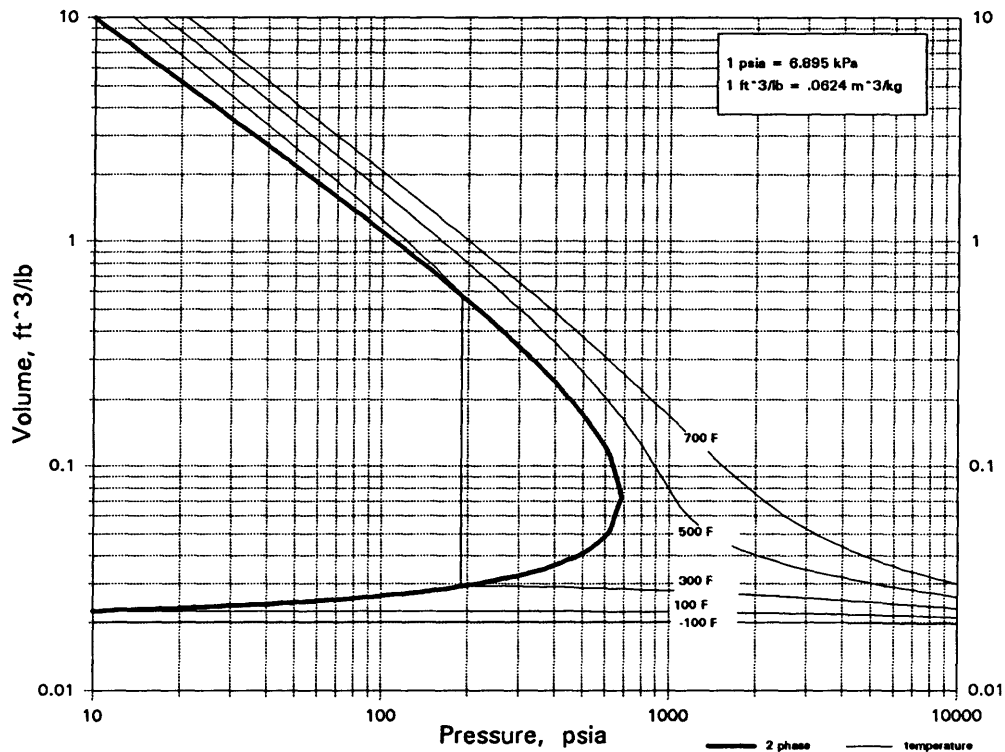


C3H8S

ISOPROPYL MERCAPTAN

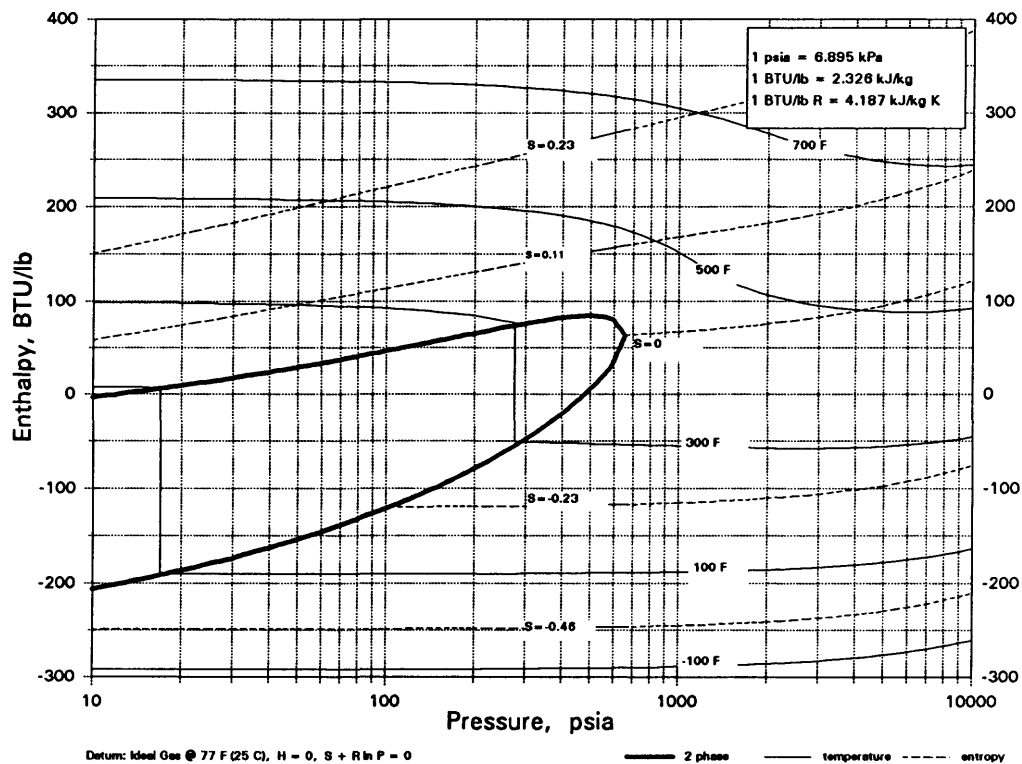
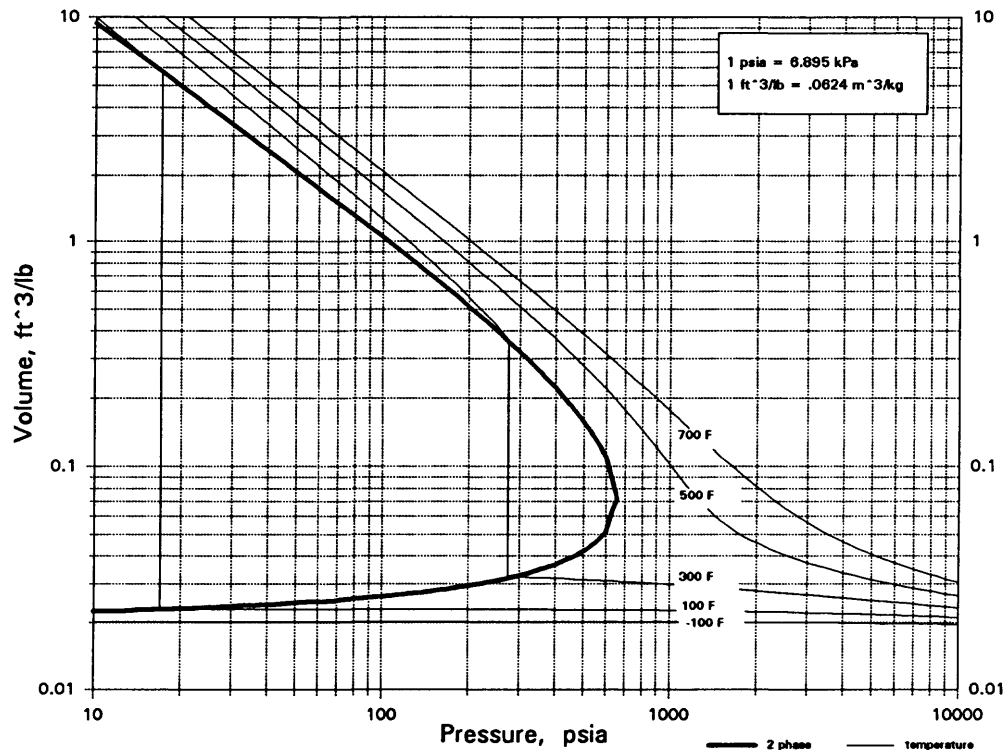


C3H9N
n-PROPYLAMINE



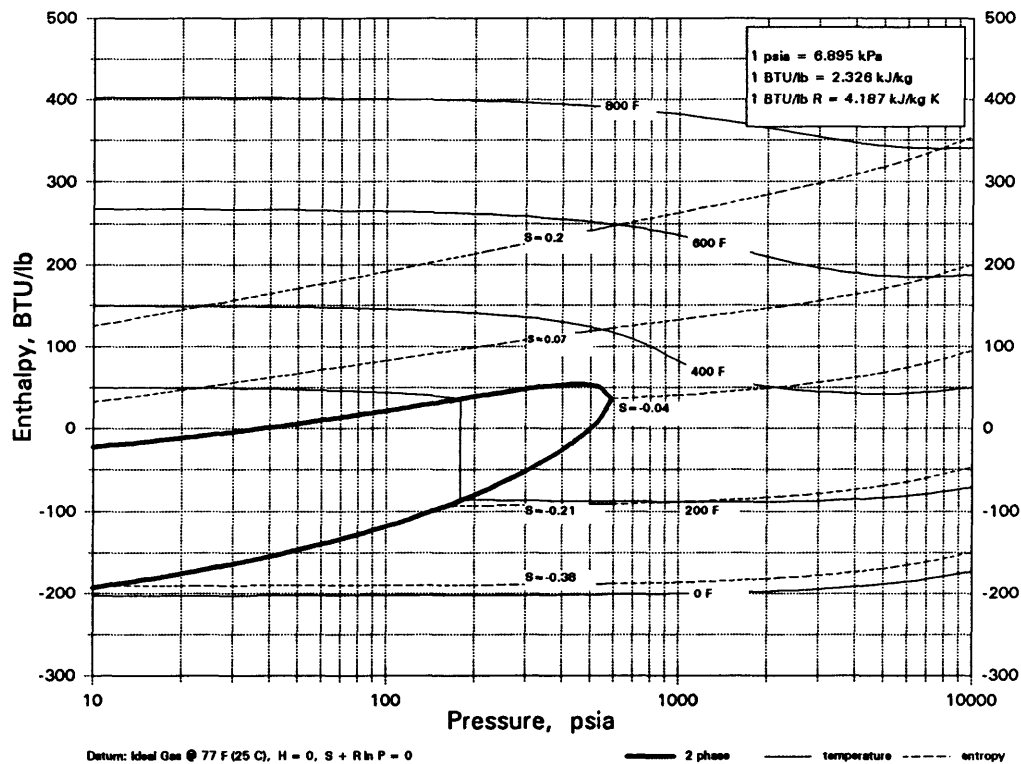
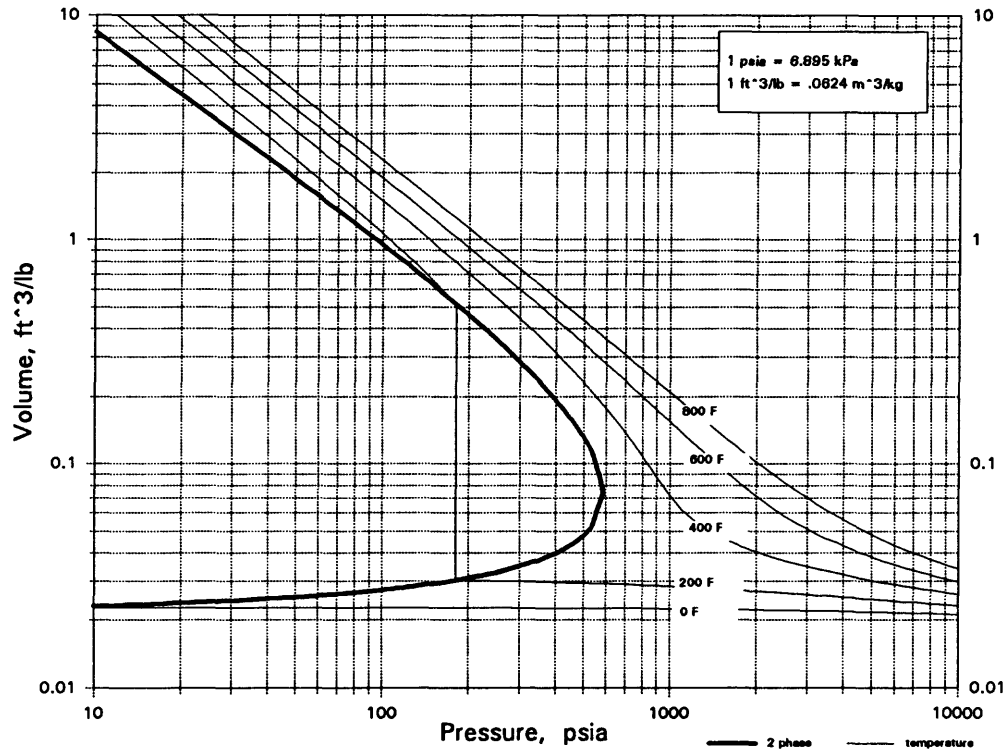
C3H9N

ISOPROPYLAMINE



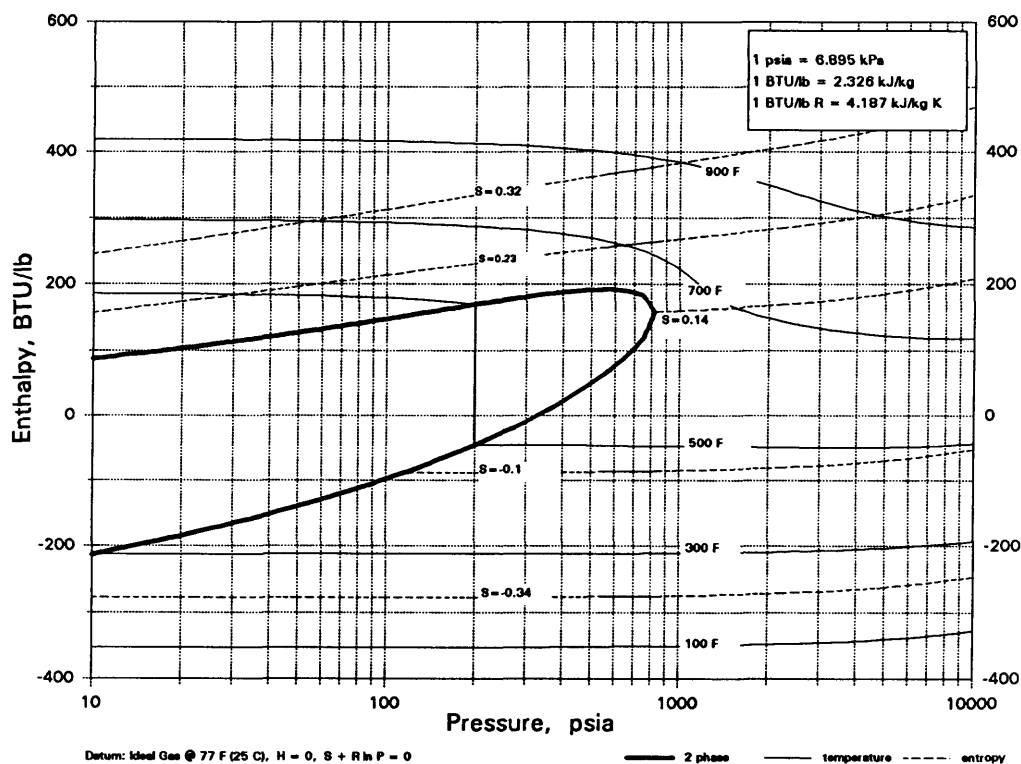
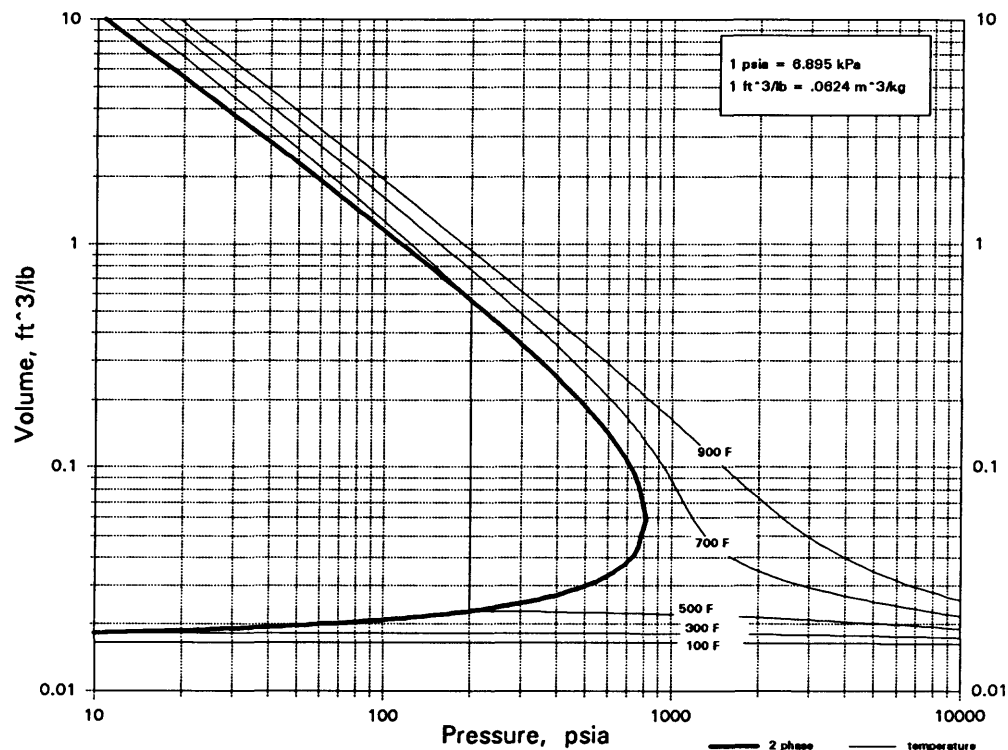
C3H9N

TRIMETHYLAMINE



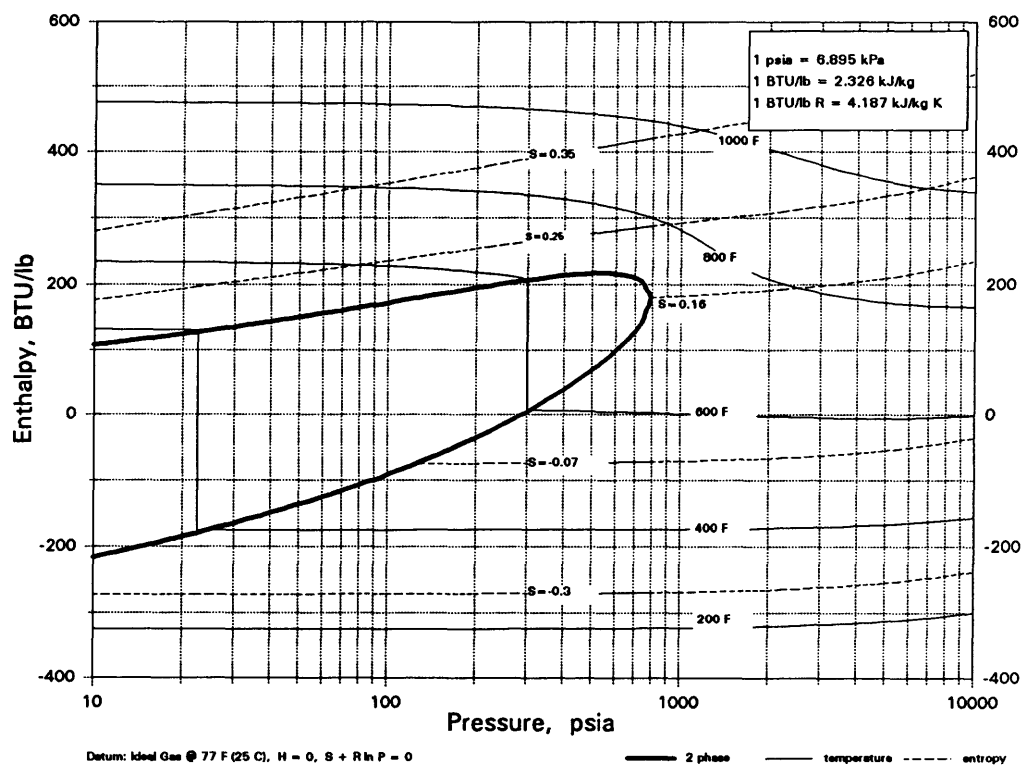
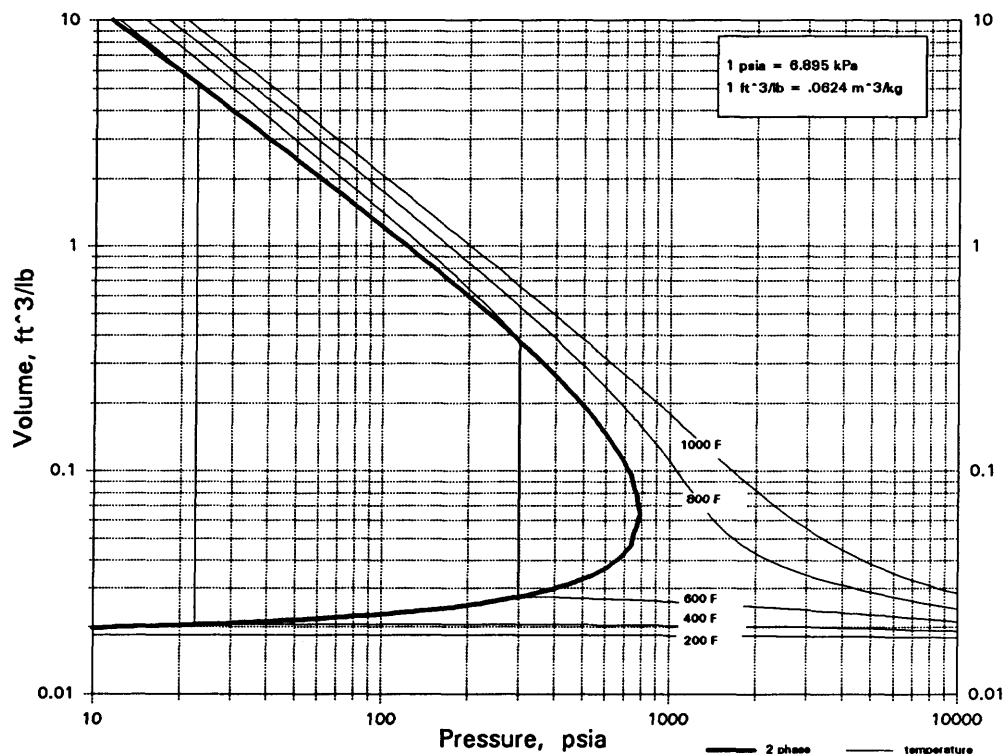
C3H9NO

1-AMINO-2-PROPANOL



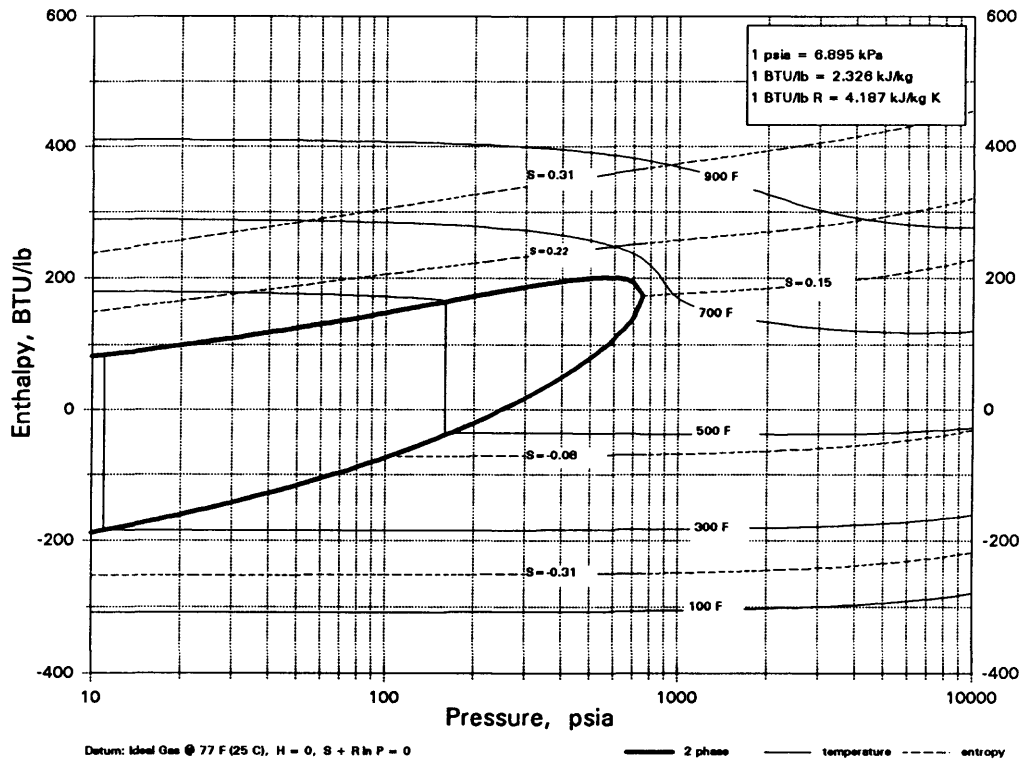
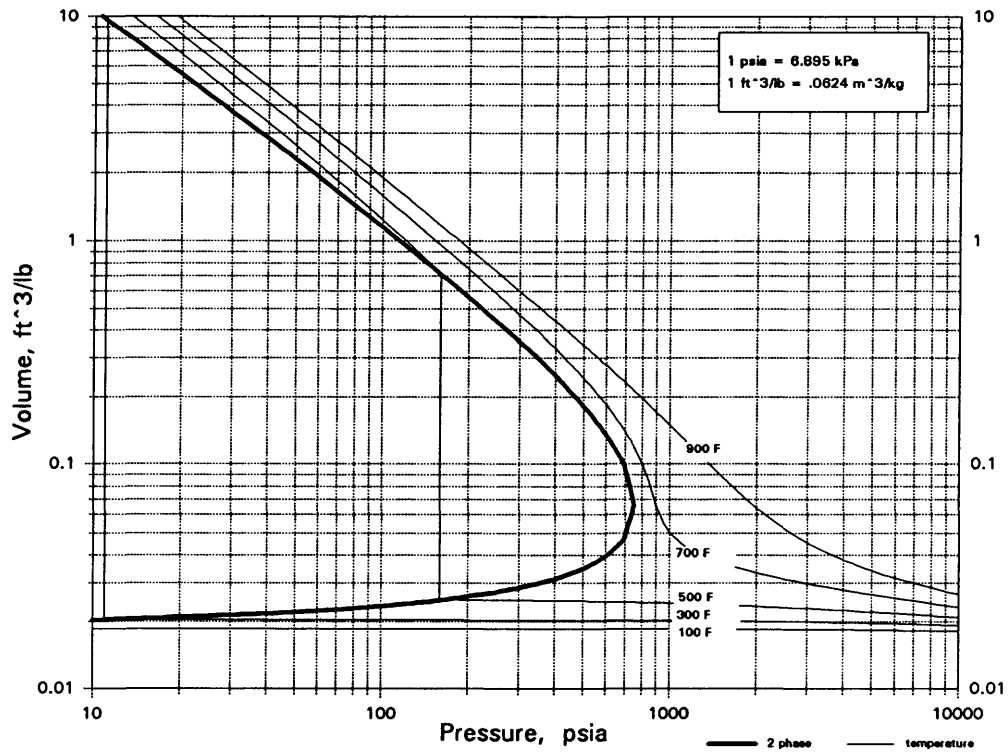
C3H9NO

3-AMINO-1-PROPANOL



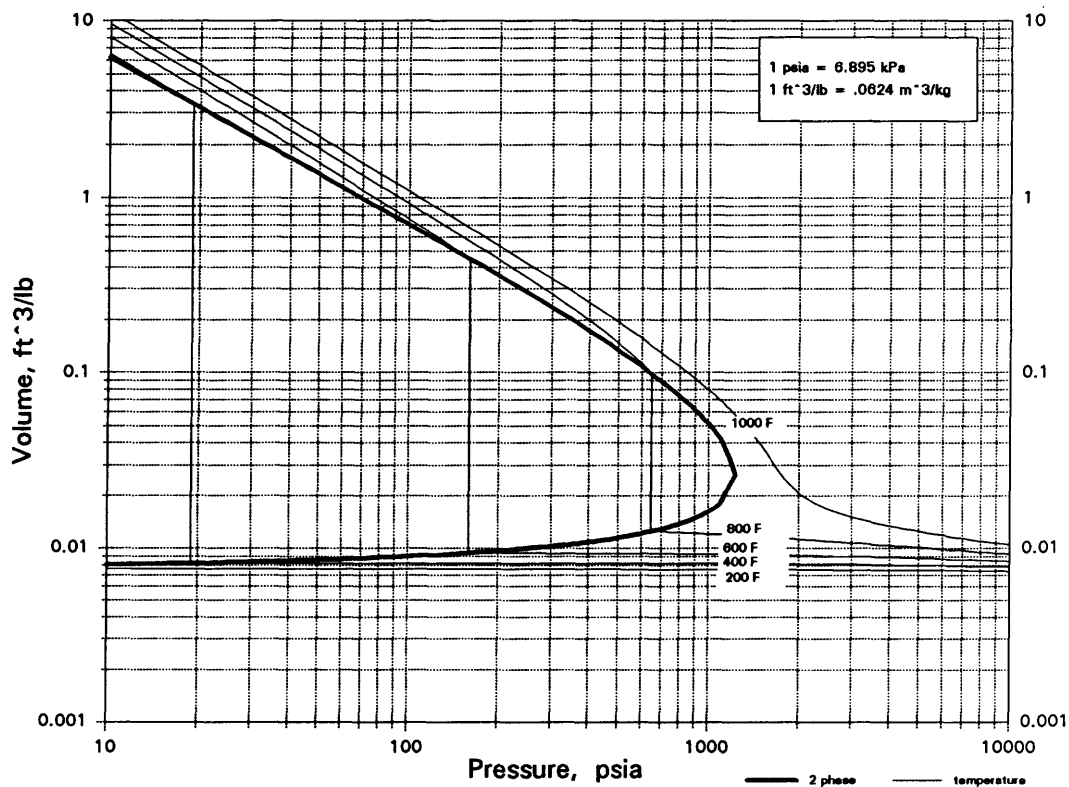
C3H9NO

METHYLETHANOLAMINE



C3H9O4P

TRIMETHYL PHOSPHATE



1. Boiling Point, K..... 465.85

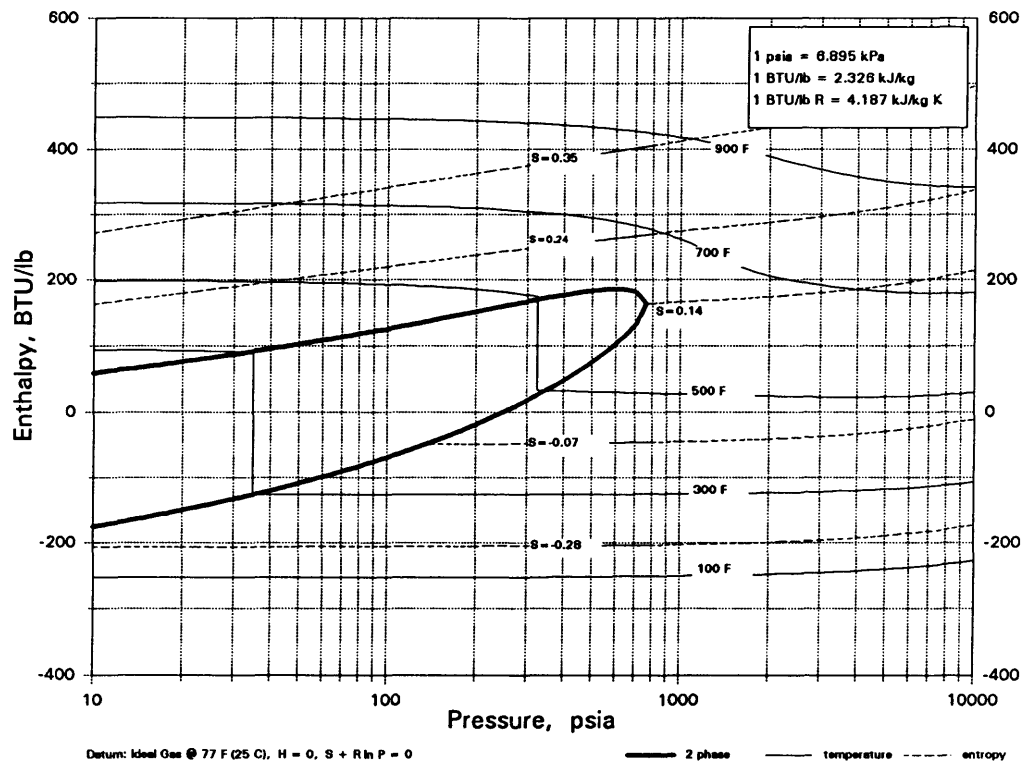
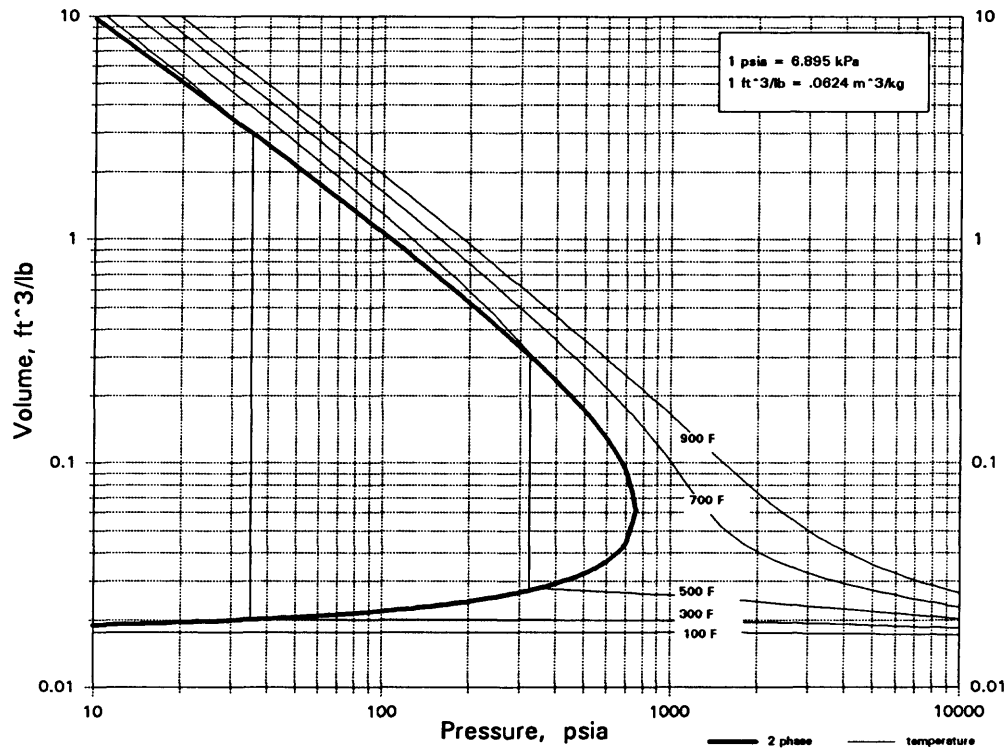
2. Critical Temperature, K.... 764.00

3. Critical Pressure, atm..... 83.89

Heat capacity data are not available.

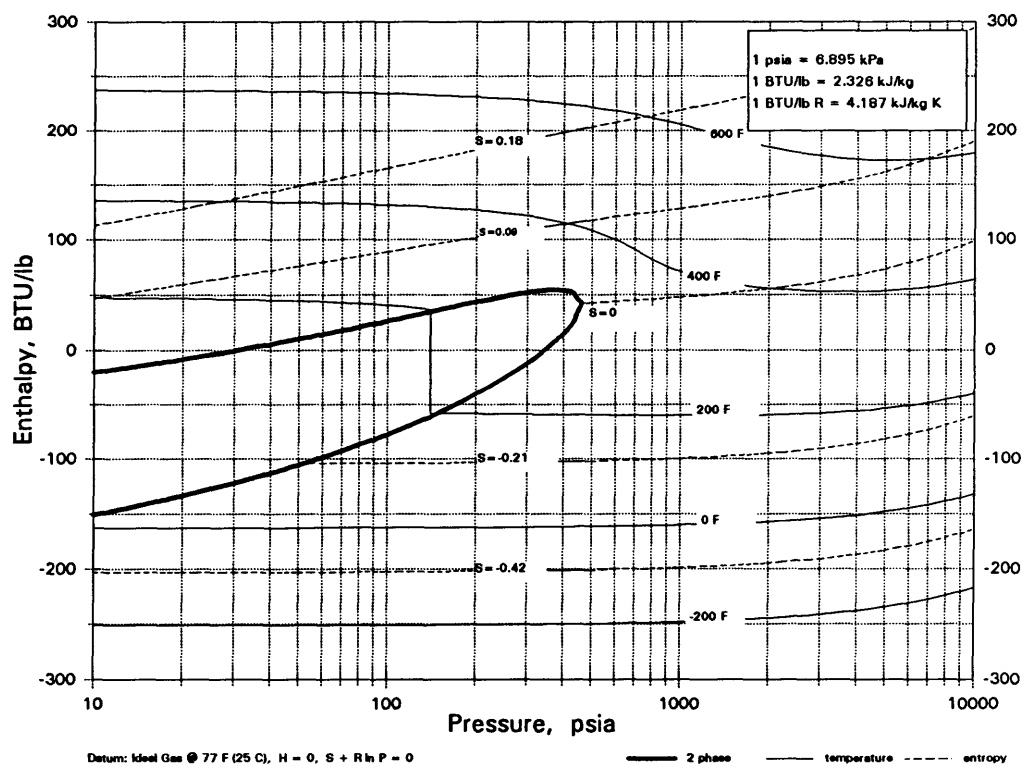
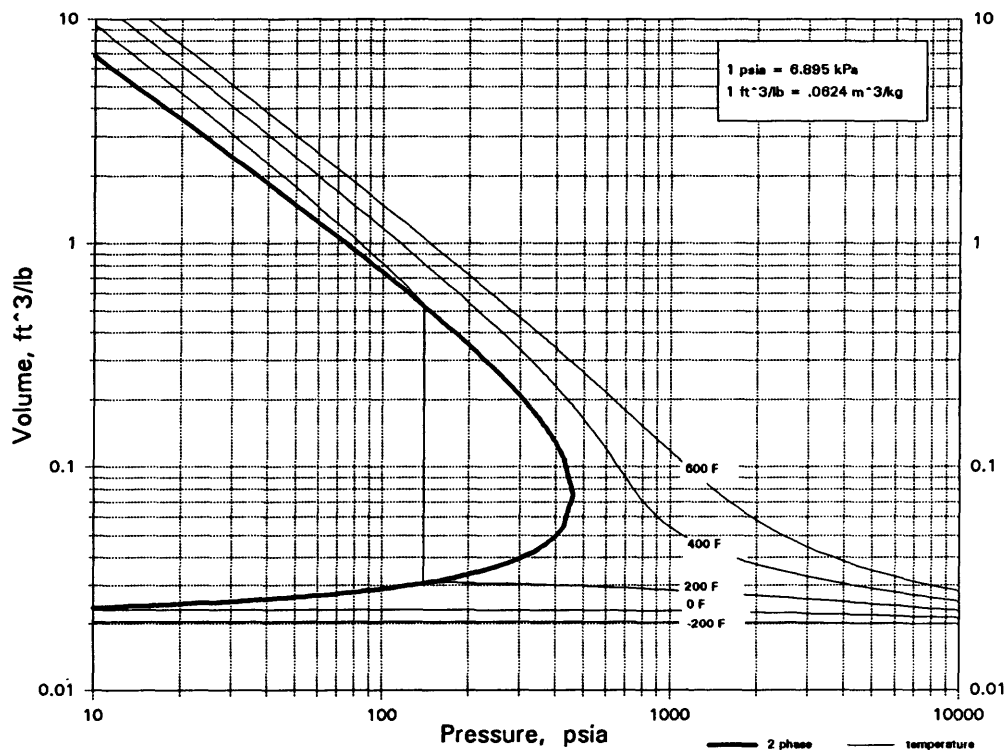
C3H10N2

1-2-PROPANEDIAMINE

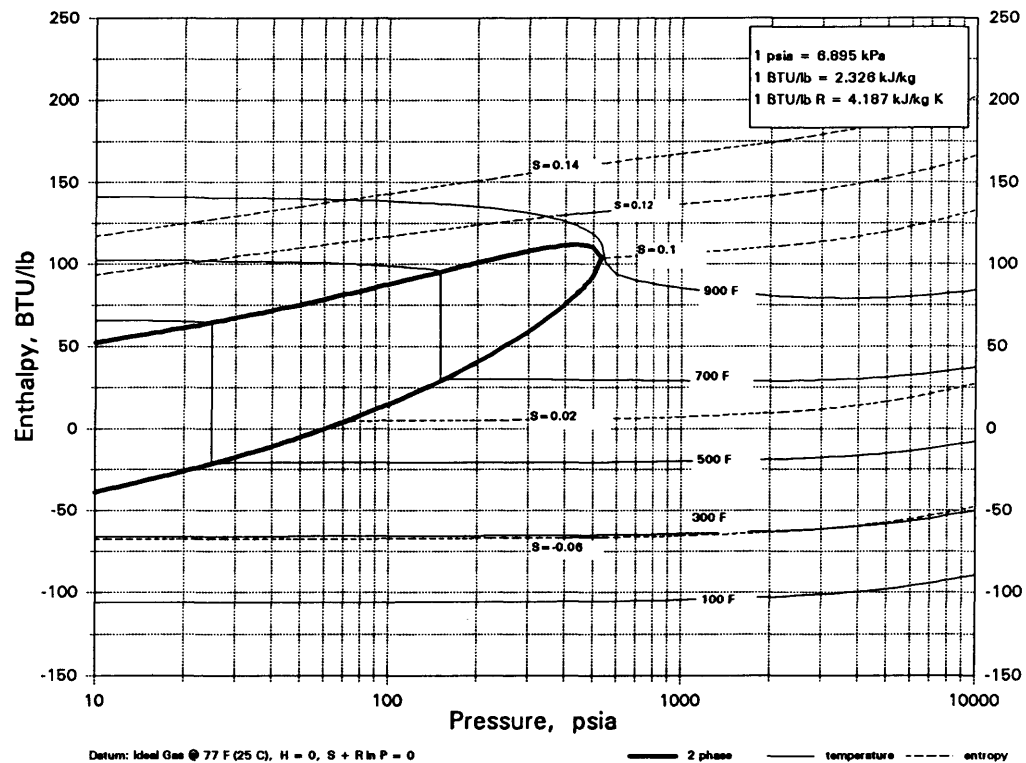
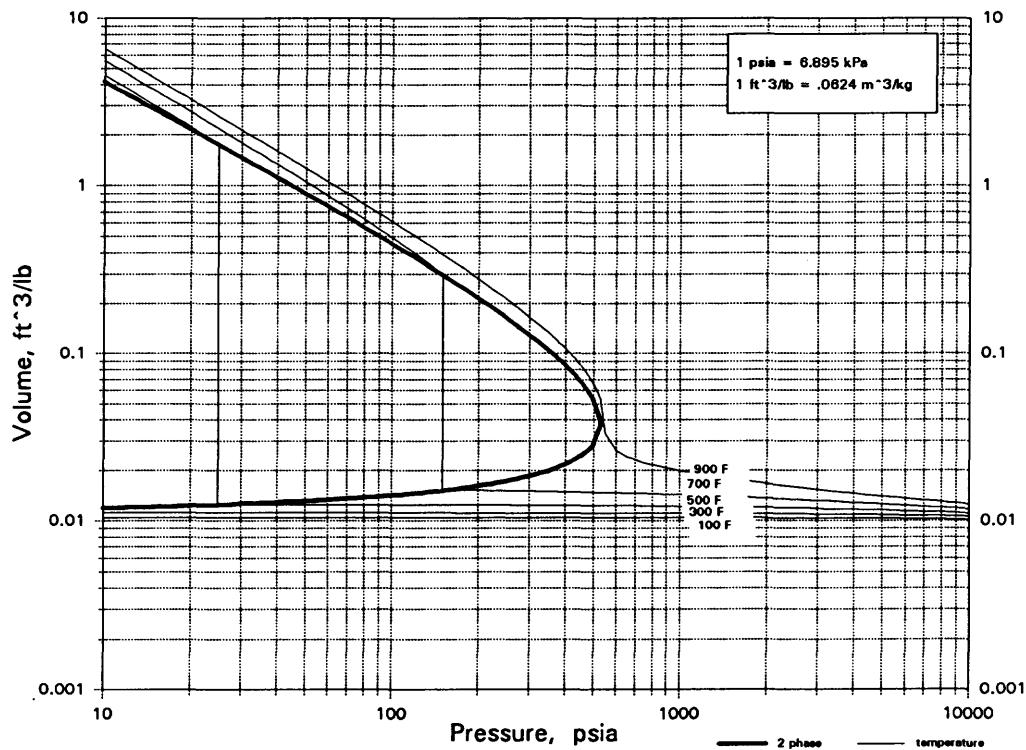


C3H10Si

TRIMETHYL SILANE

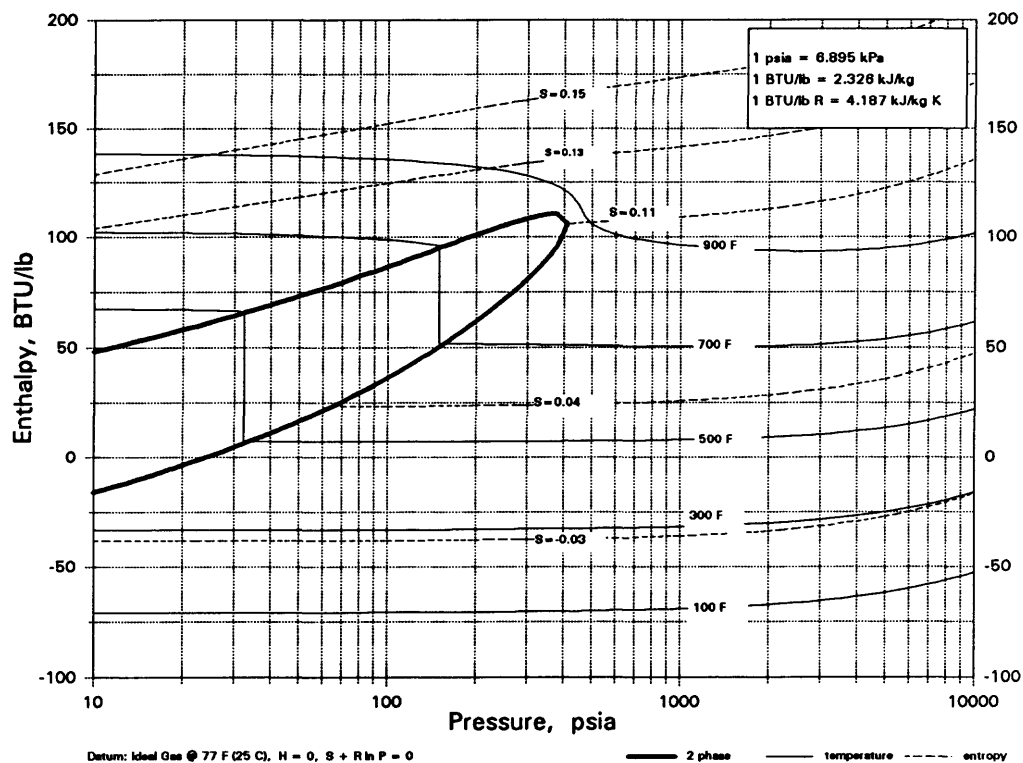
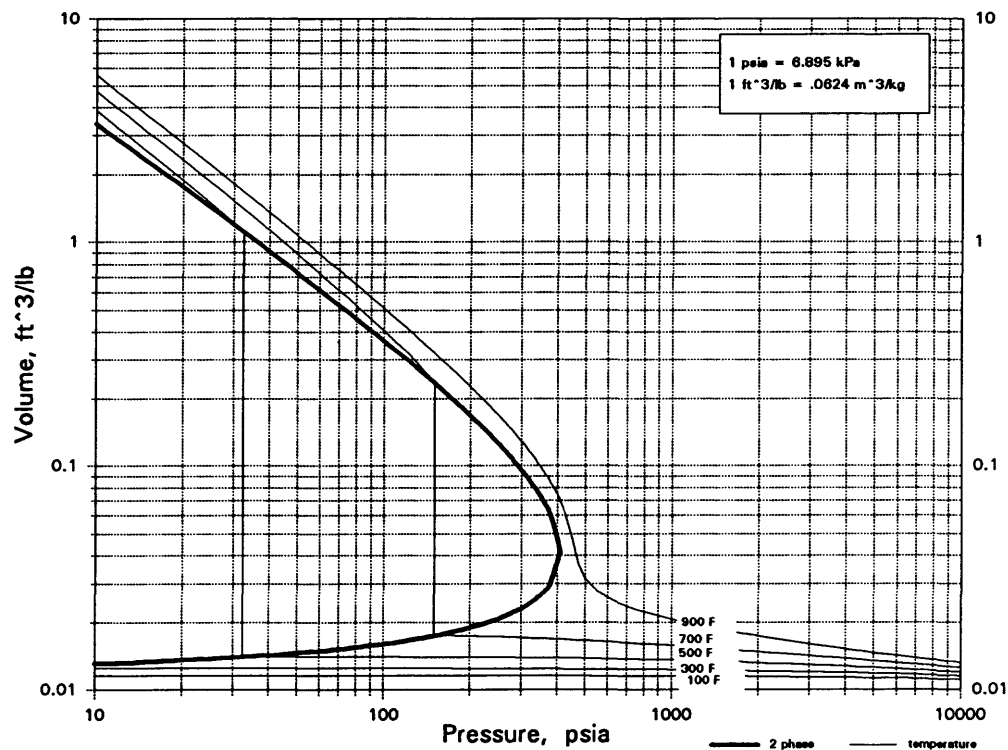


C4Cl4S
TETRACHLOROTHIOPHENE



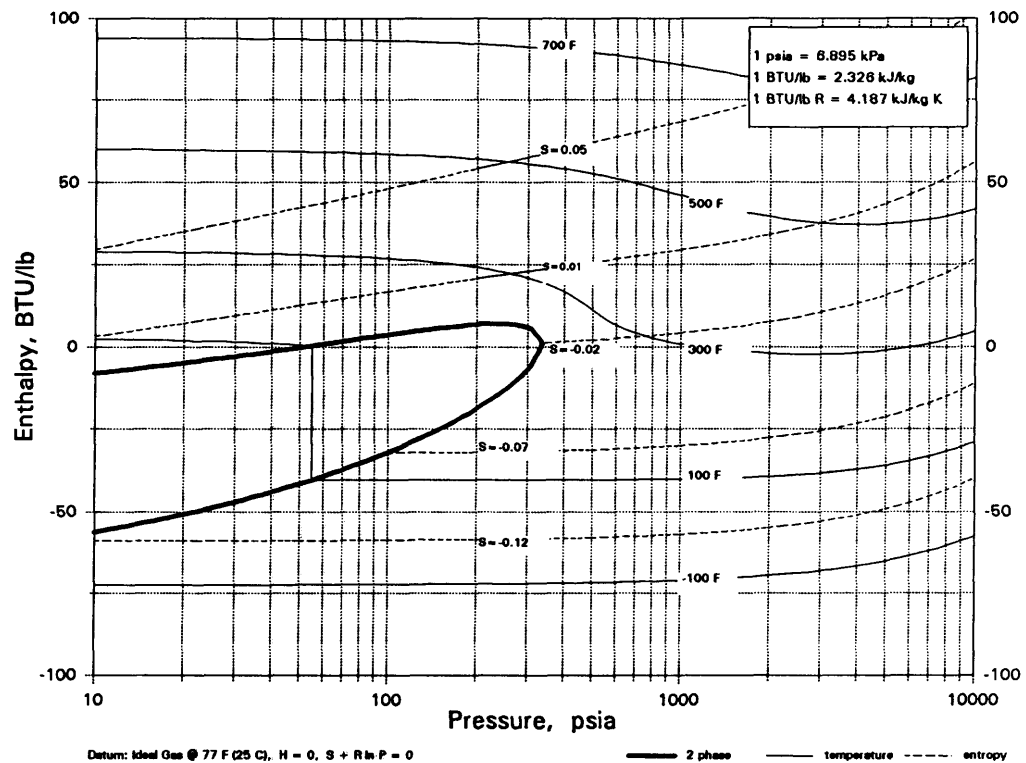
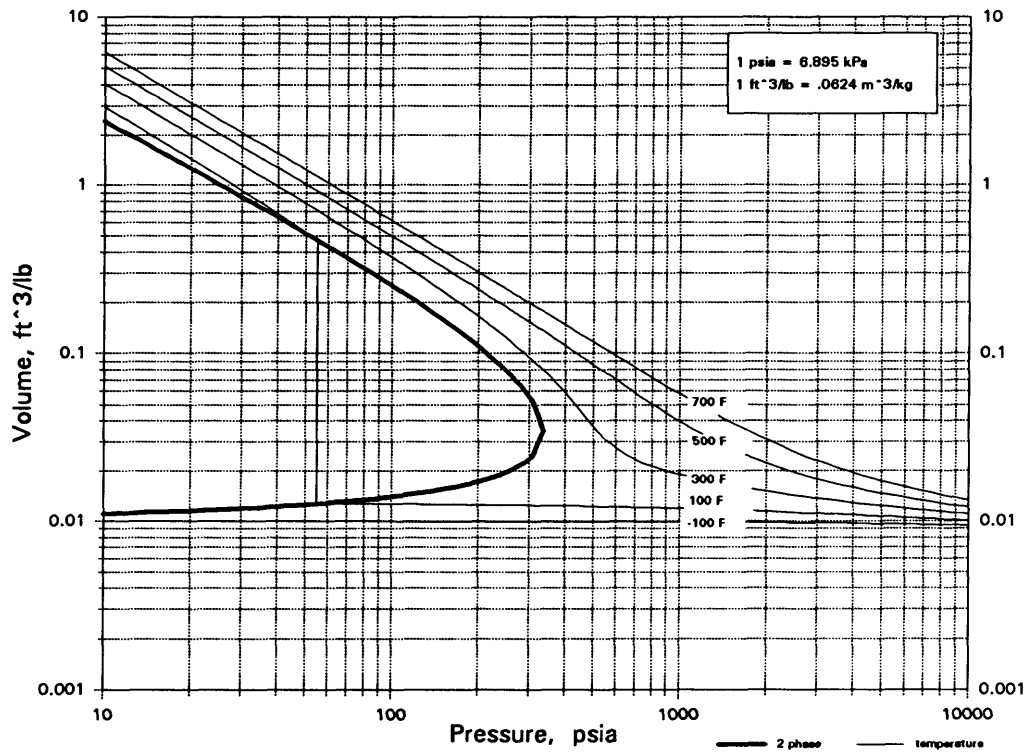
C4Cl6

HEXACHLORO-1-3-BUTADIENE



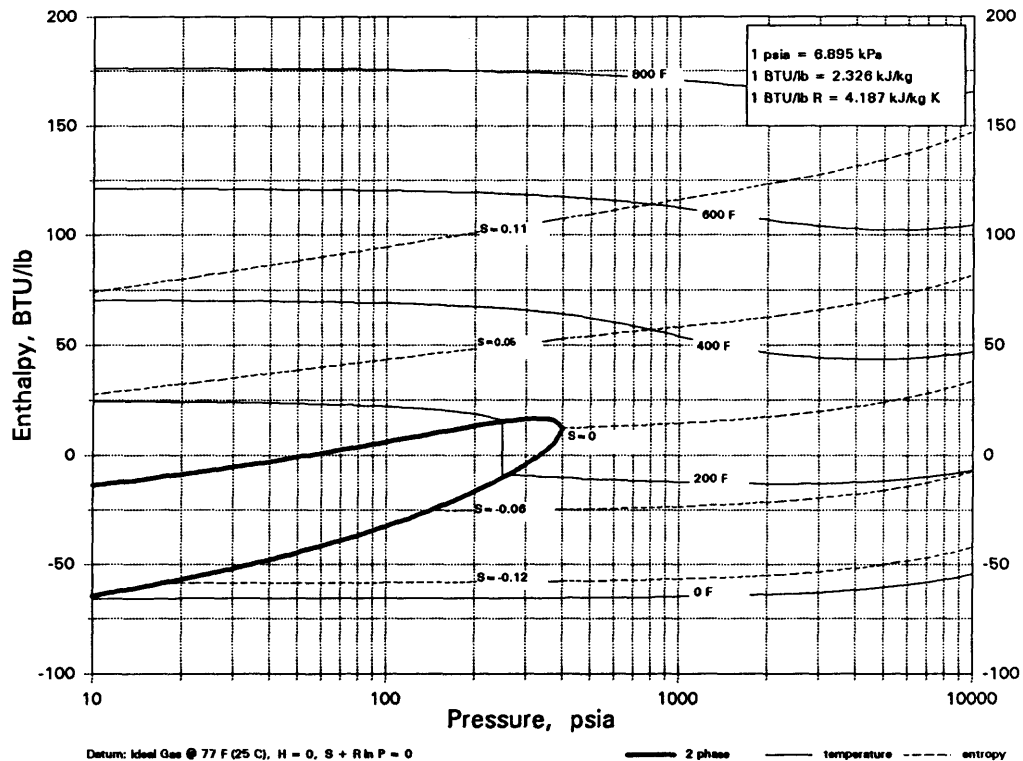
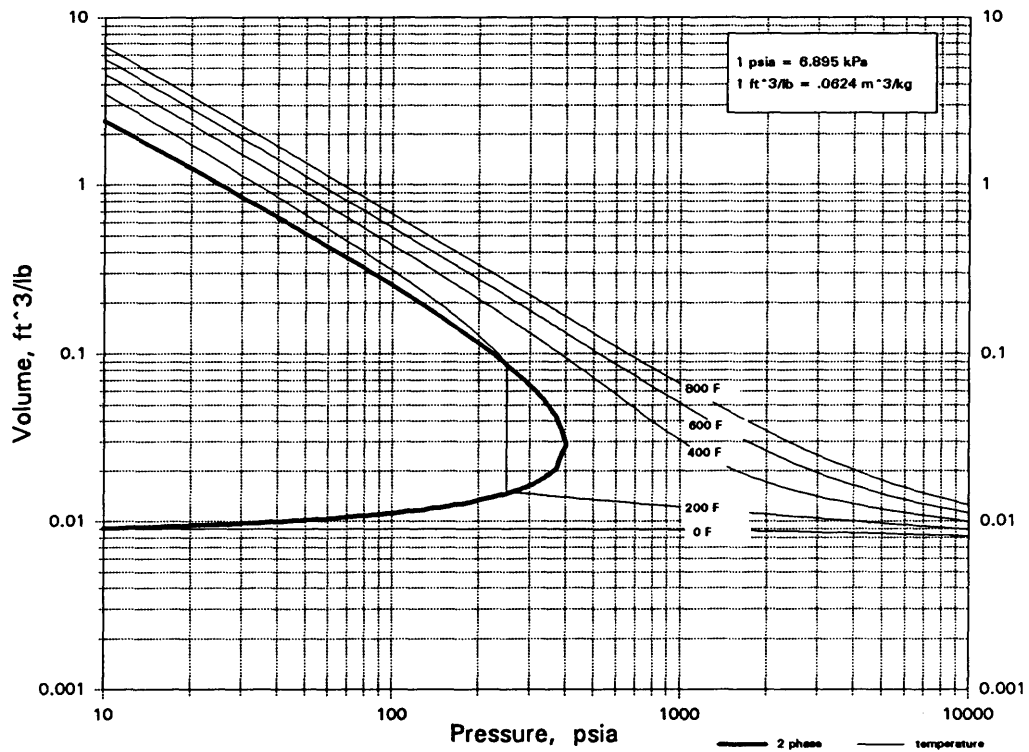
C4F8

OCTAFLUORO-2-BUTENE

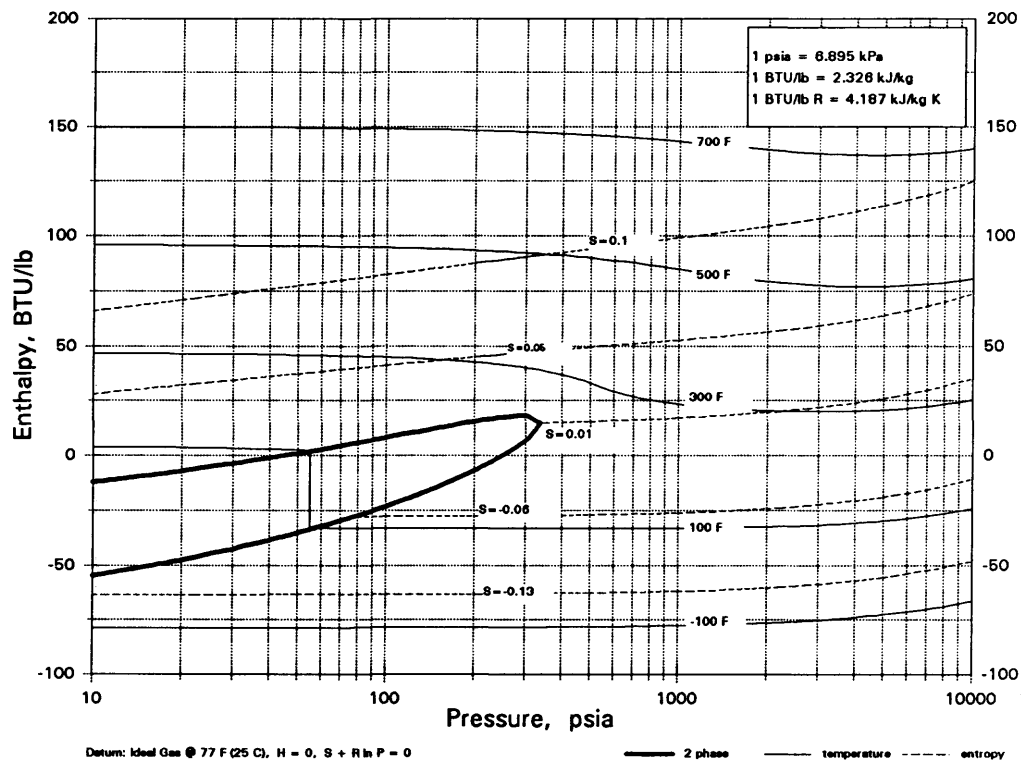
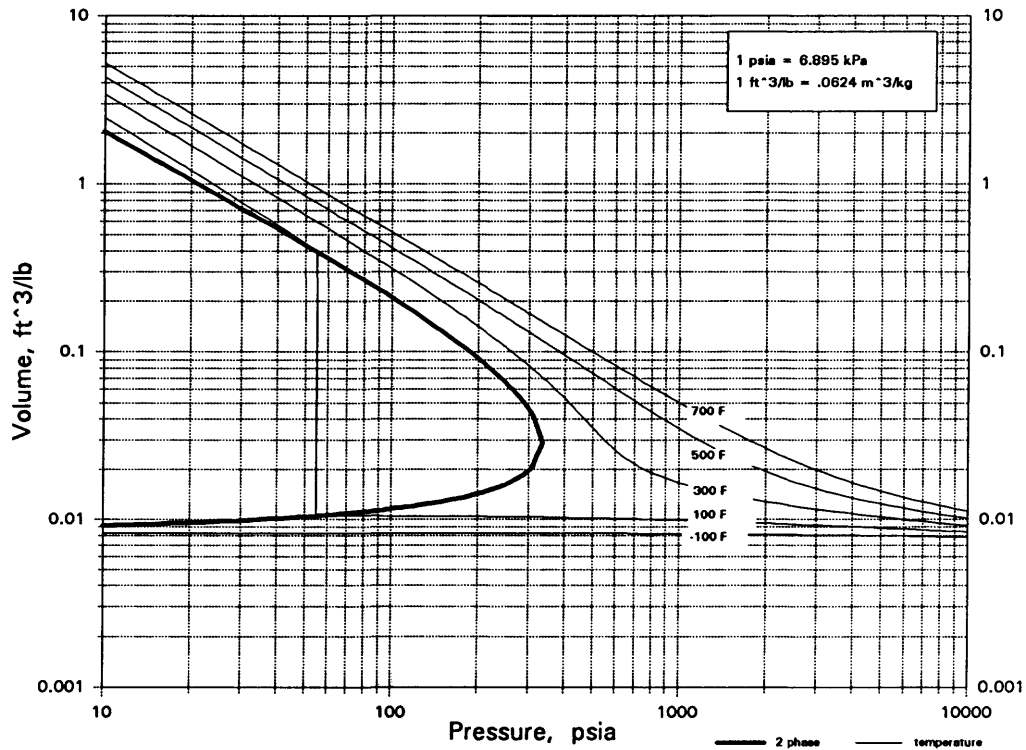


C4F8

OCTAFLUOROCYCLOBUTANE

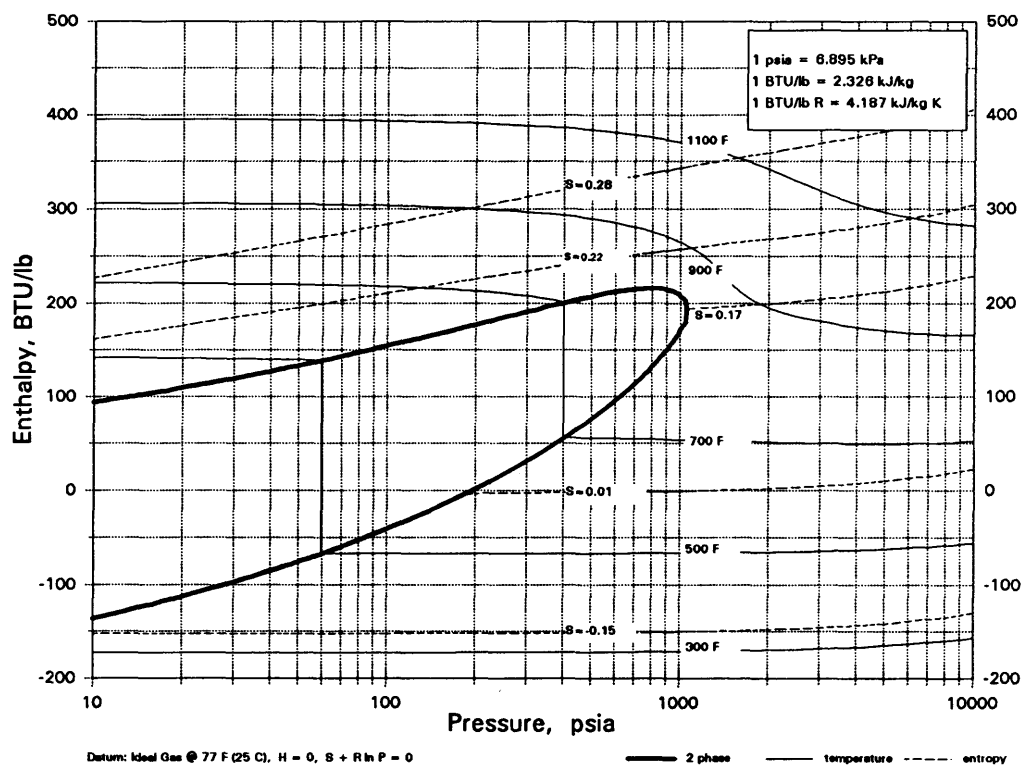
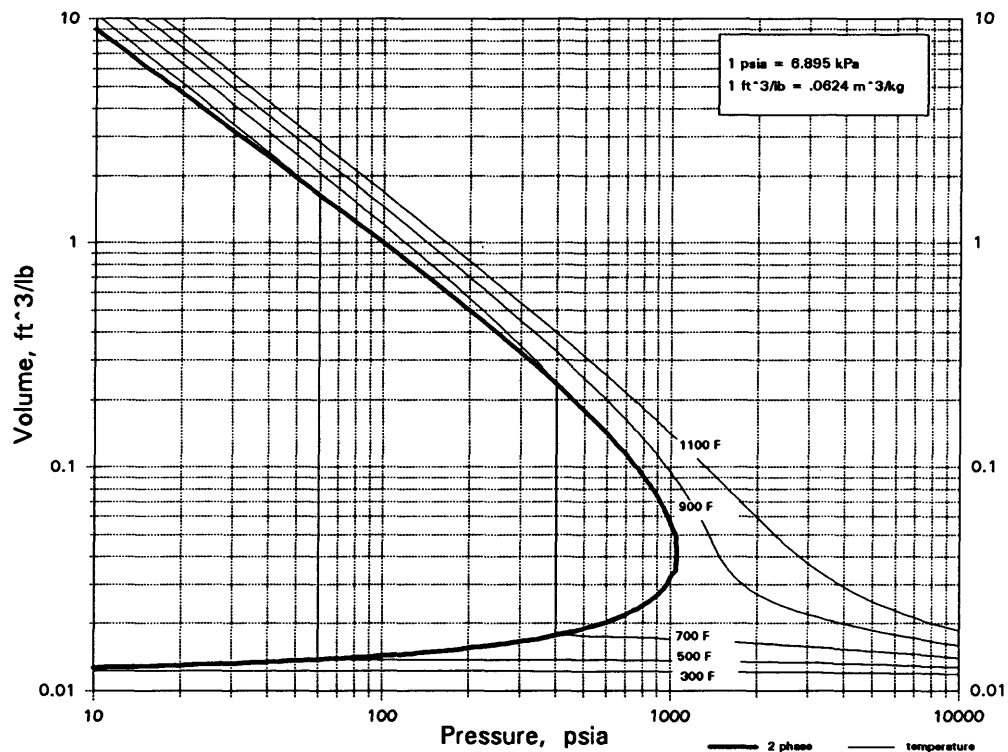


C4F10
DECAFLUOROBUTANE



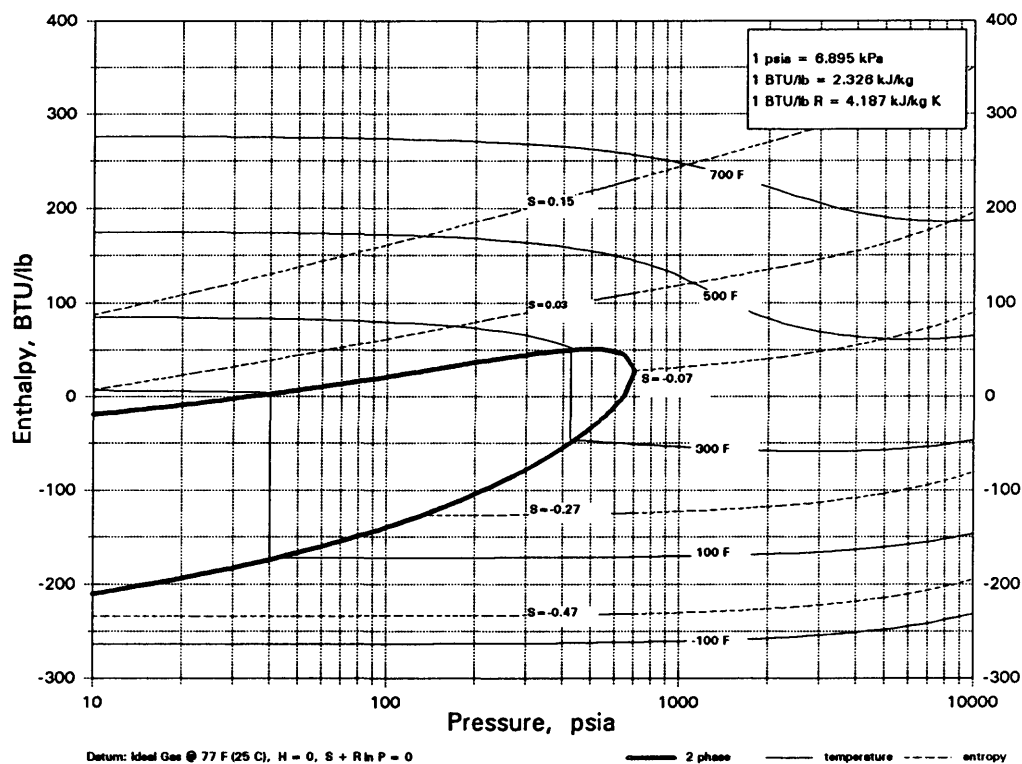
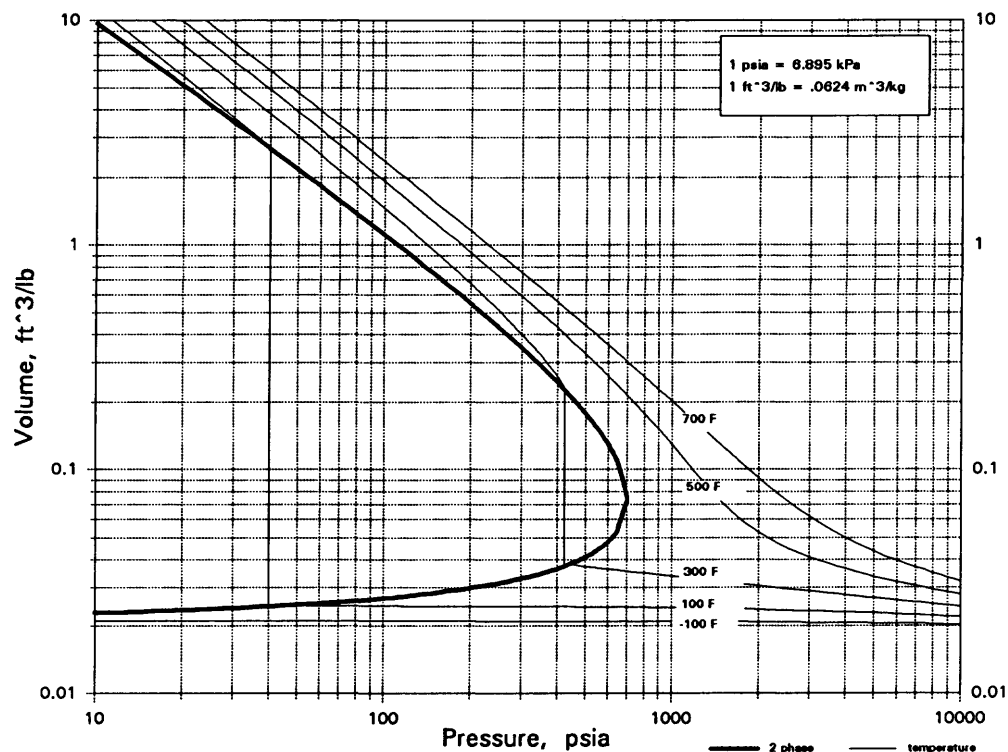
C₄H₂O₃

MALEIC ANHYDRIDE



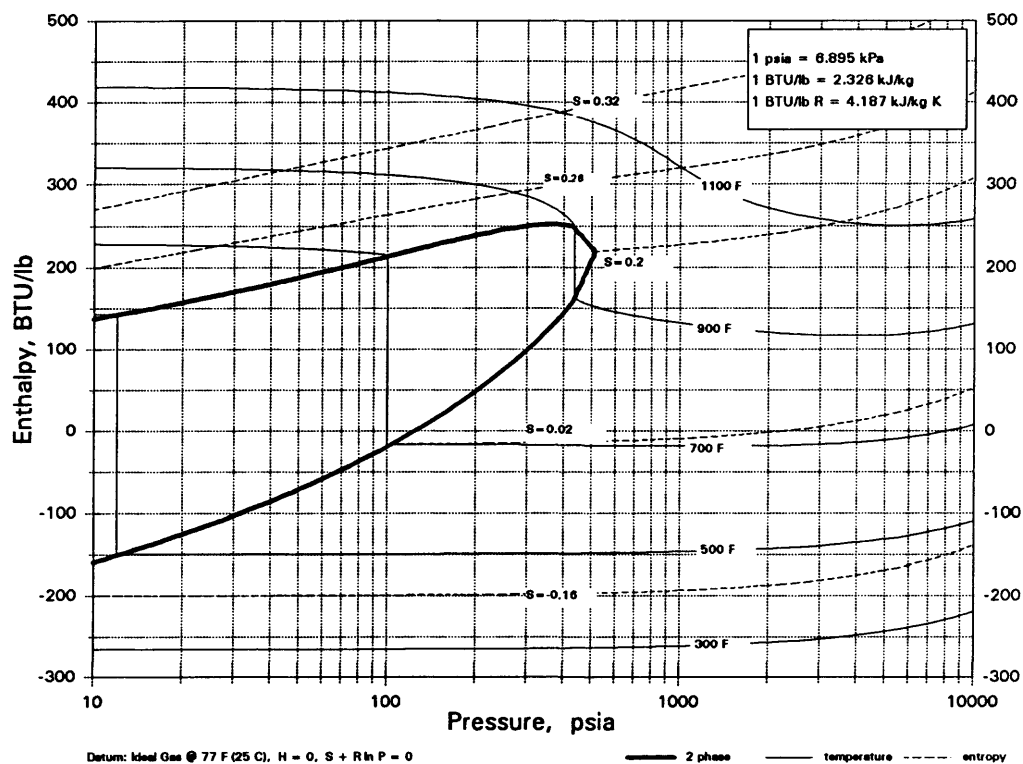
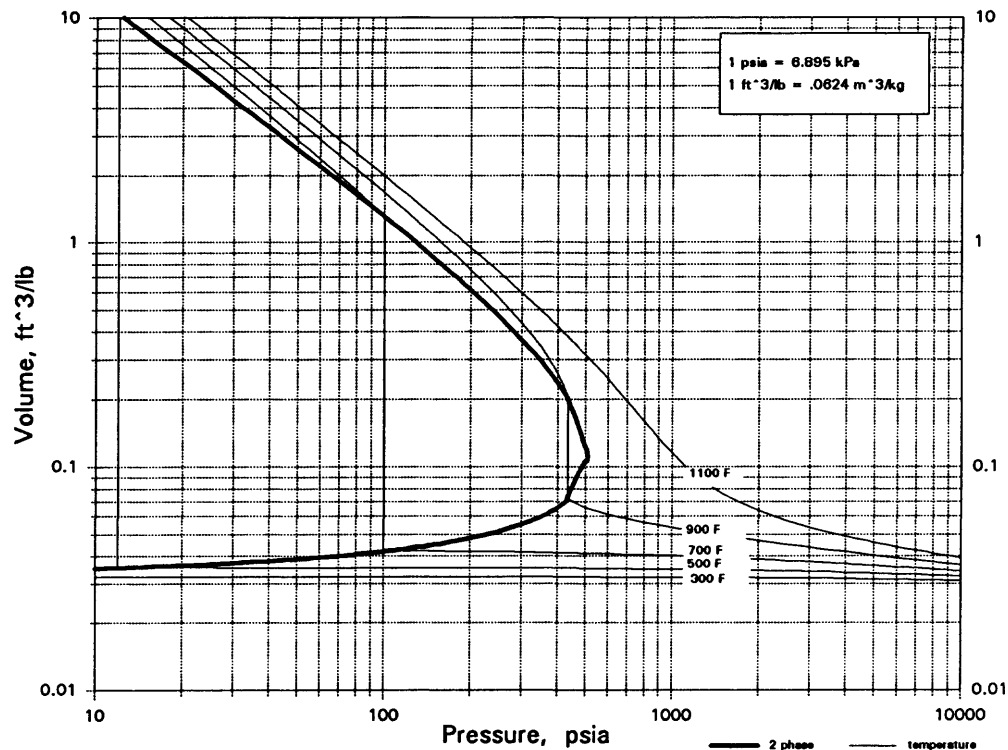
C4H4

VINYLACETYLENE

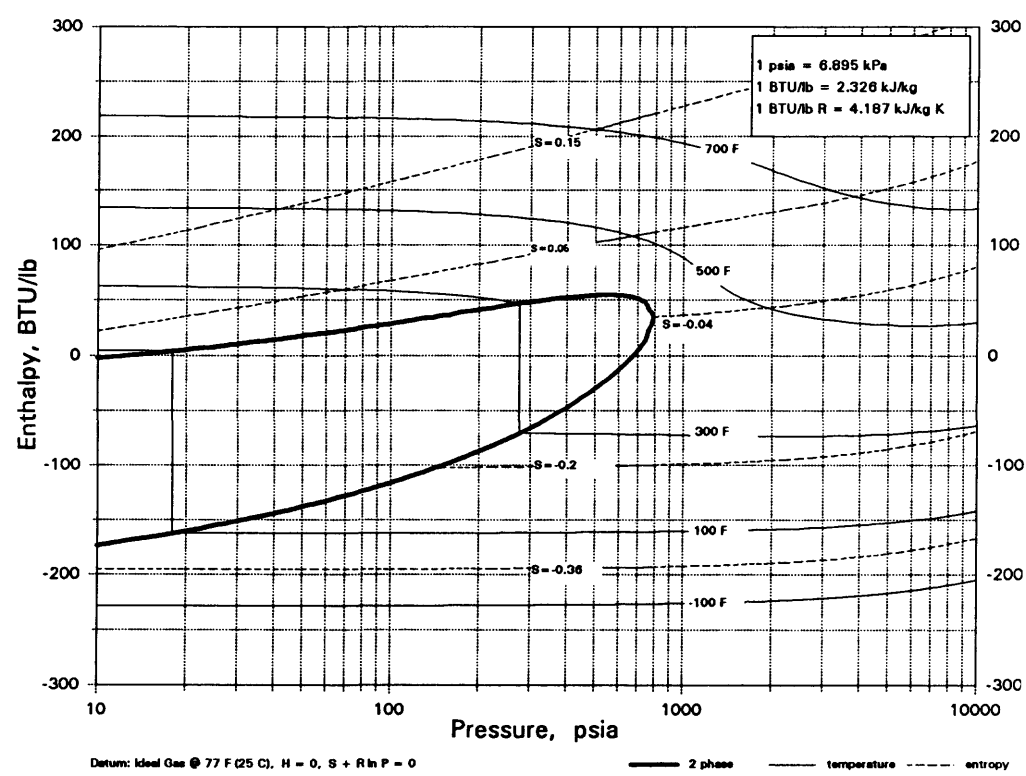
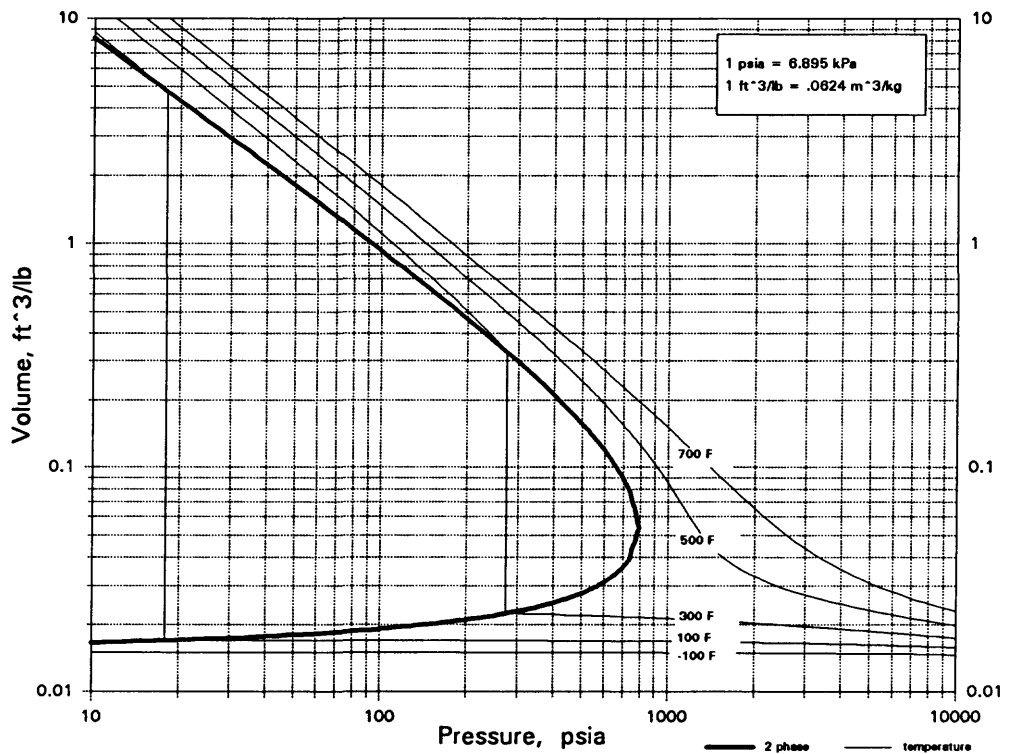


C4H4N2

SUCCINONITRILE

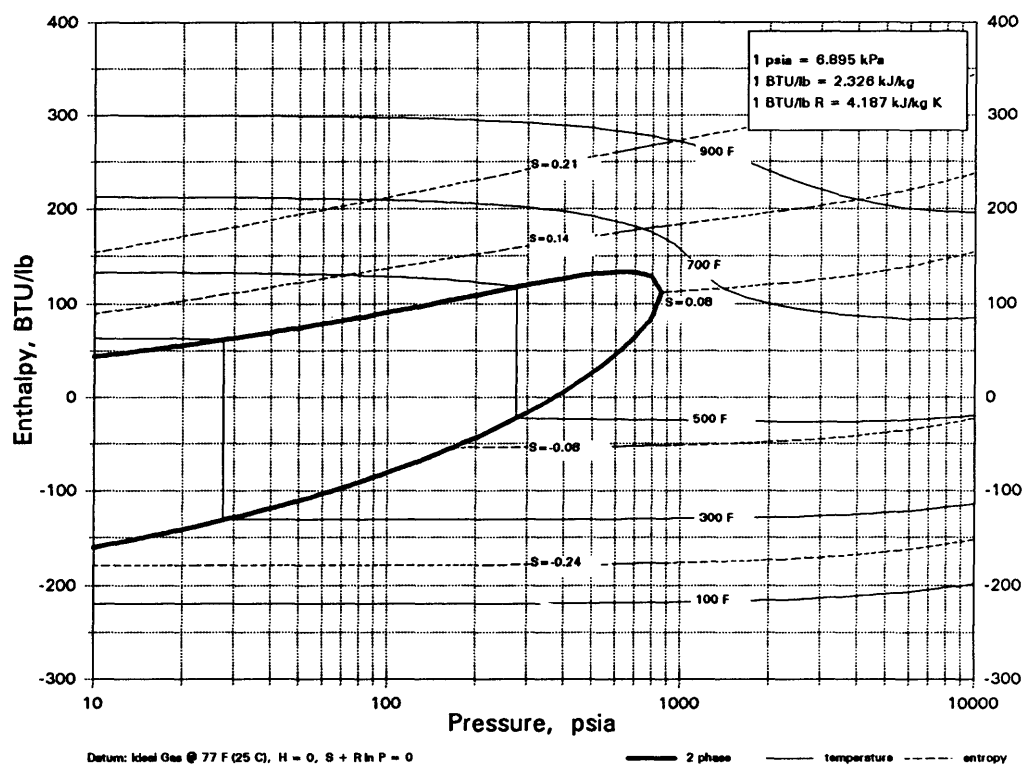
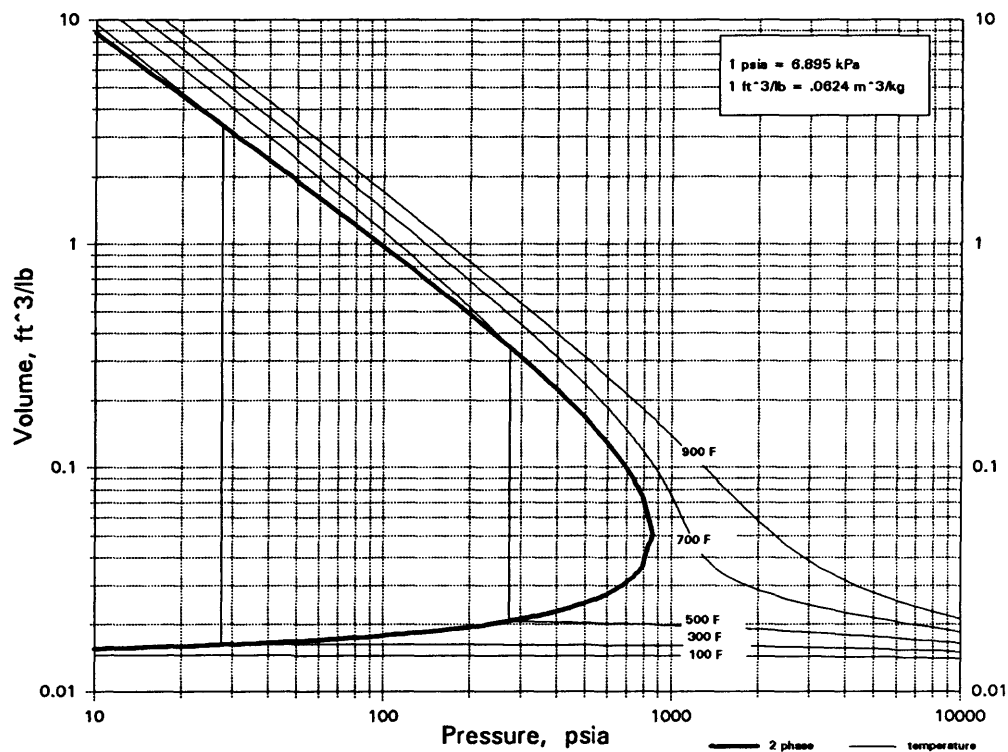


C4H4O
FURAN

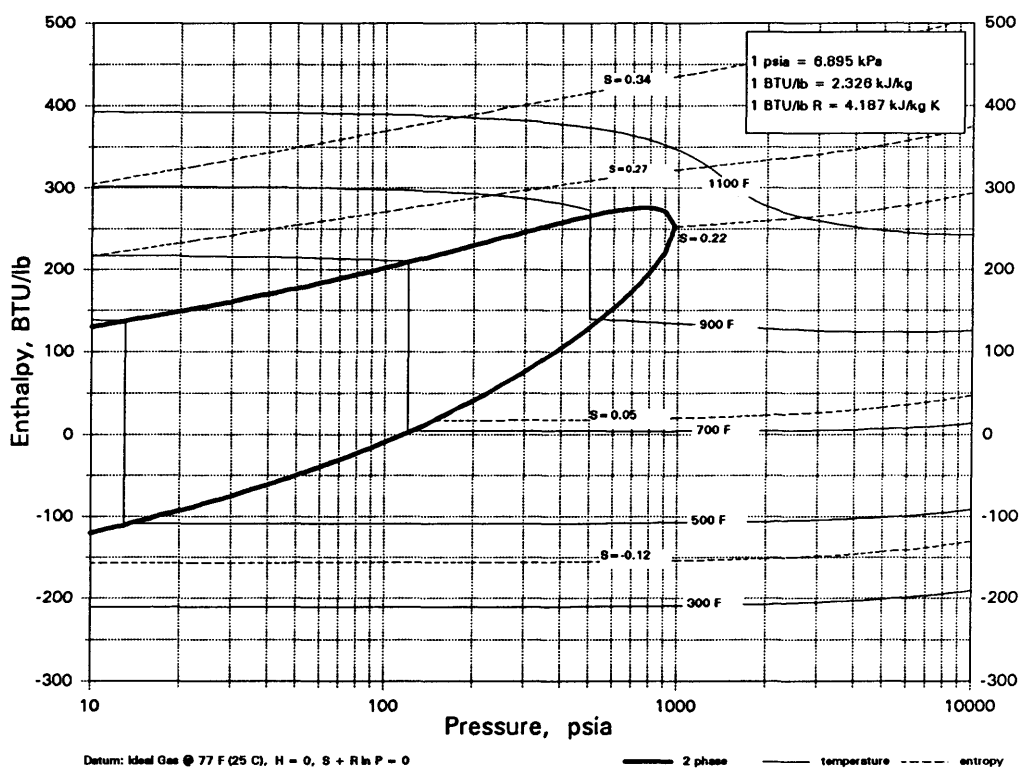
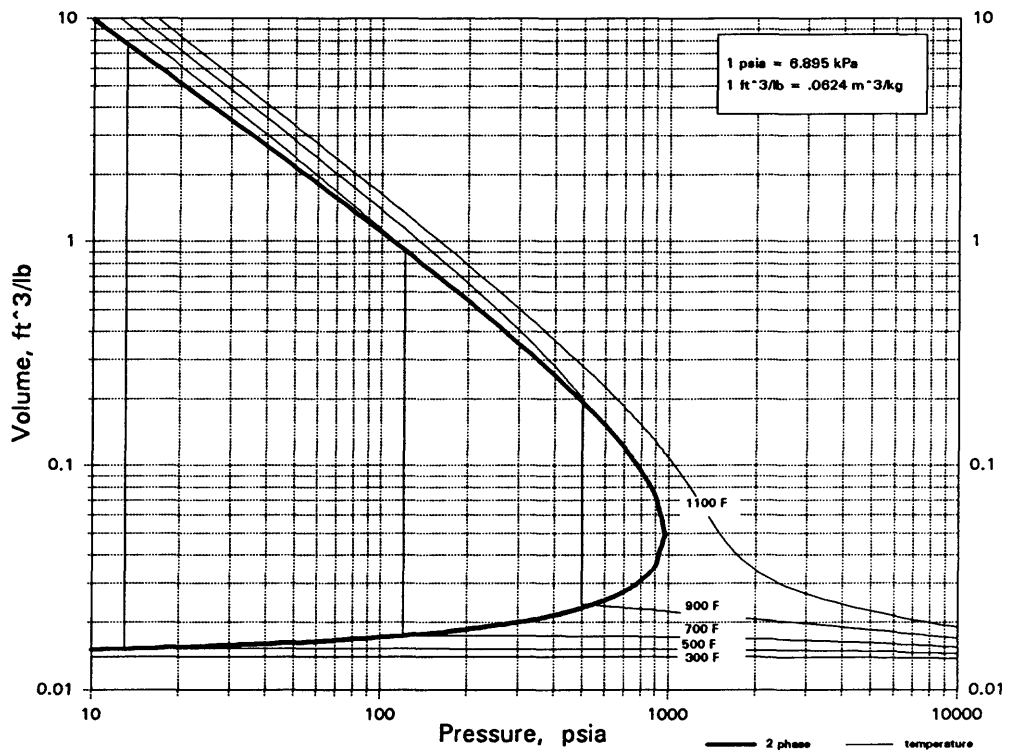


C4H4O2

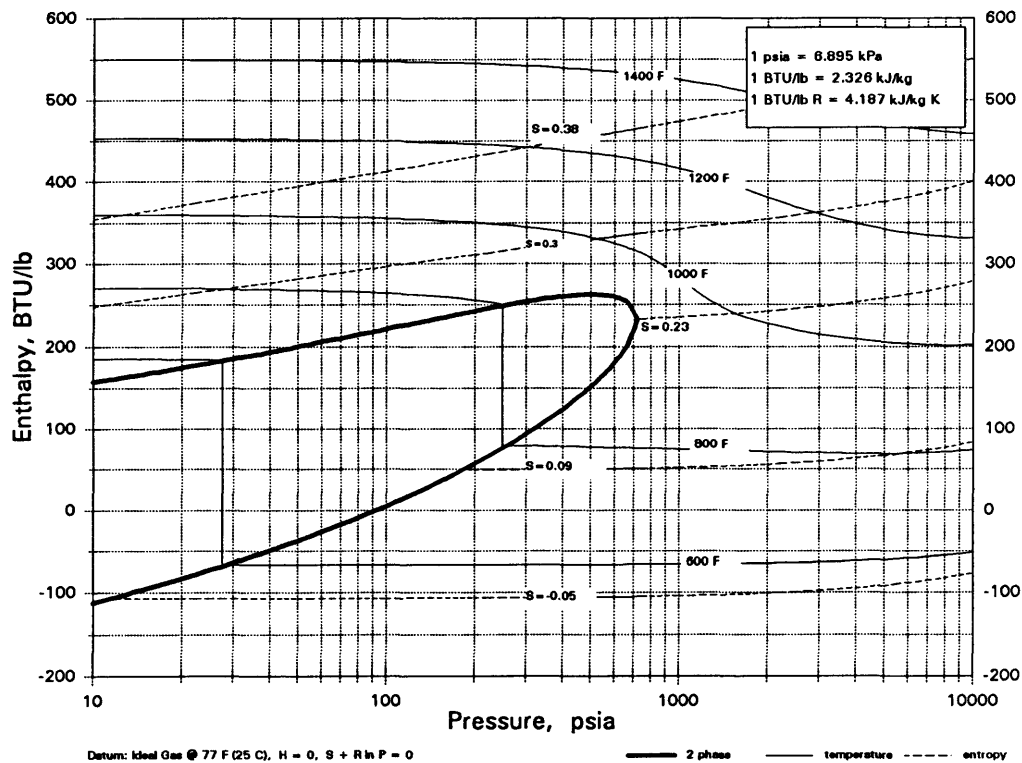
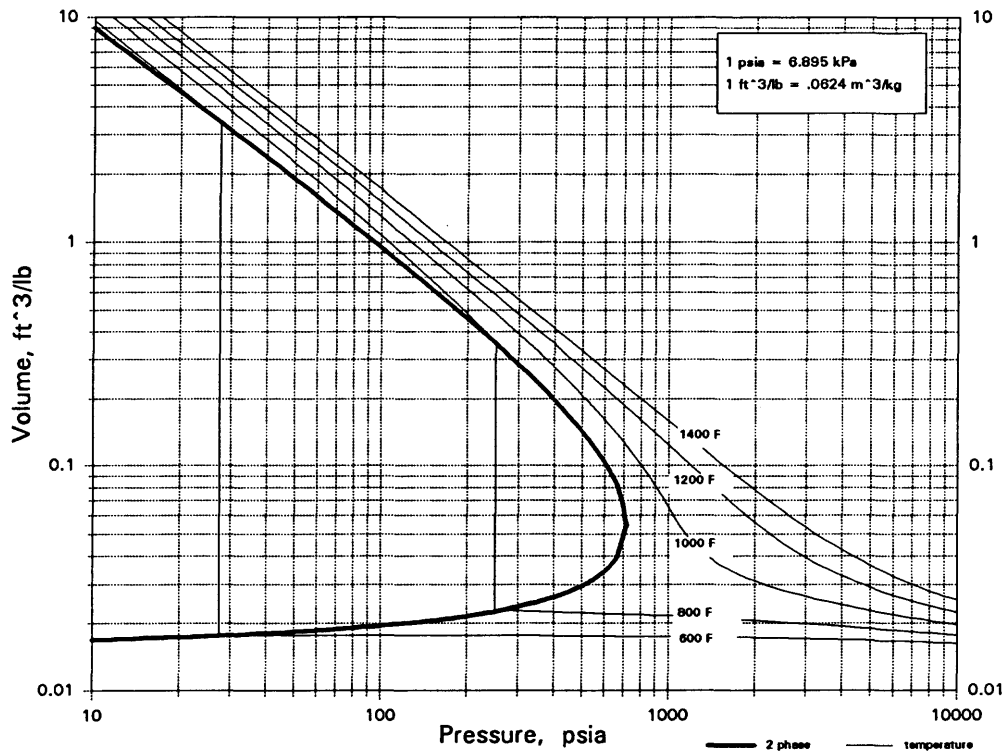
DIKETENE



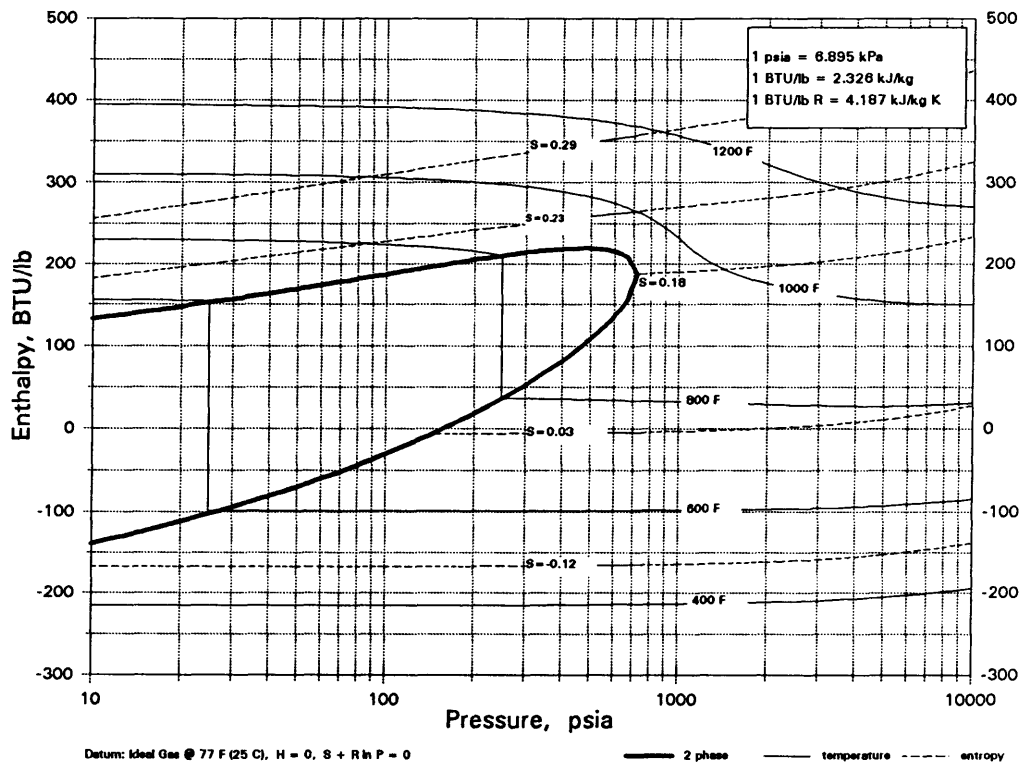
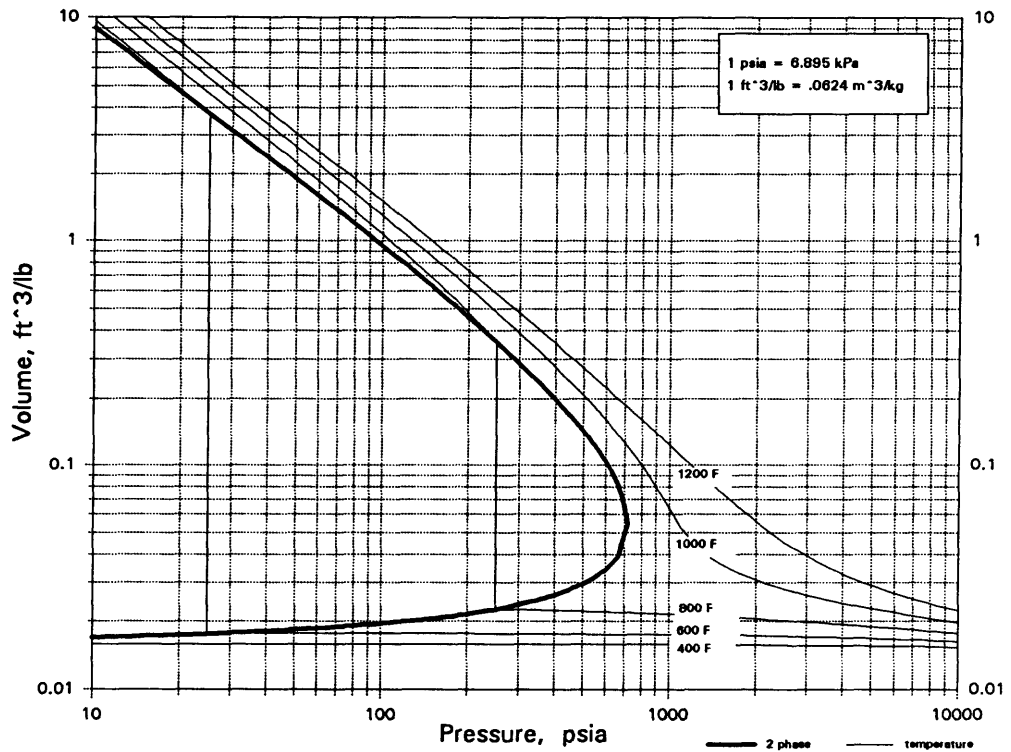
C4H4O3
SUCCINIC ANHYDRIDE



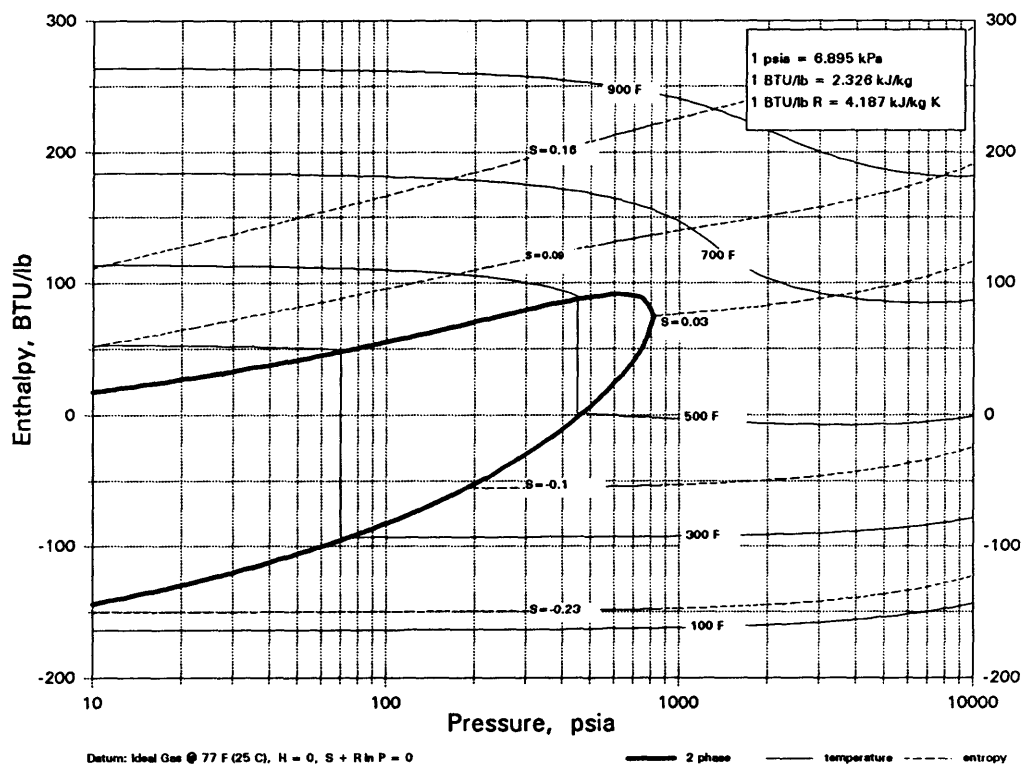
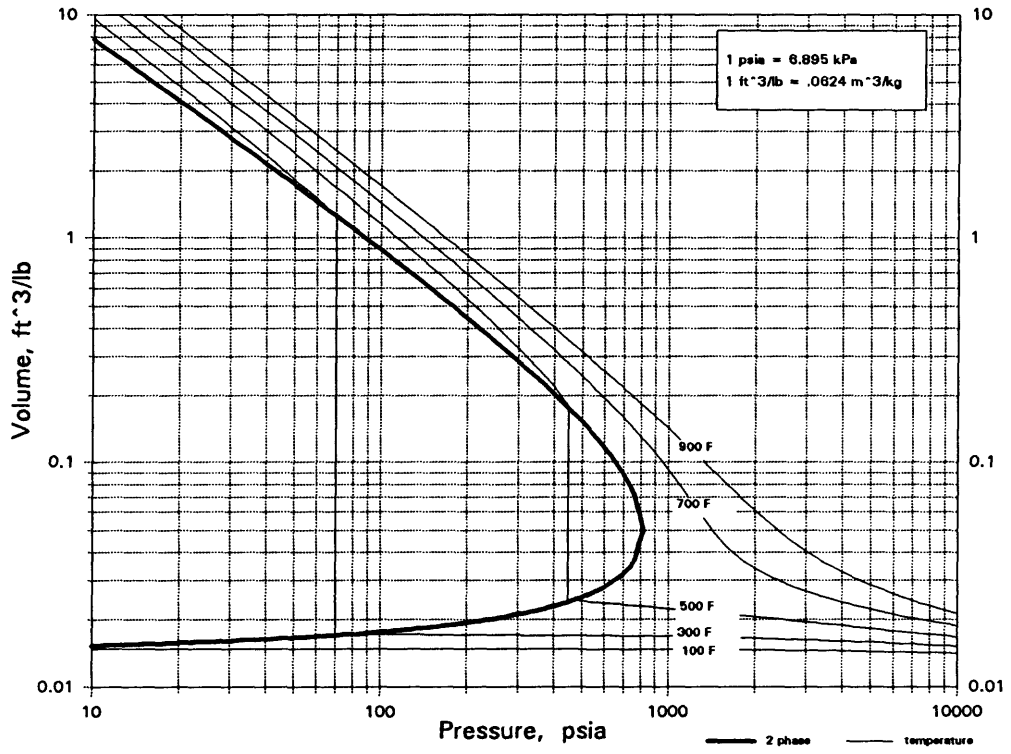
C4H4O4
FUMARIC ACID



C4H4O4
MALEIC ACID

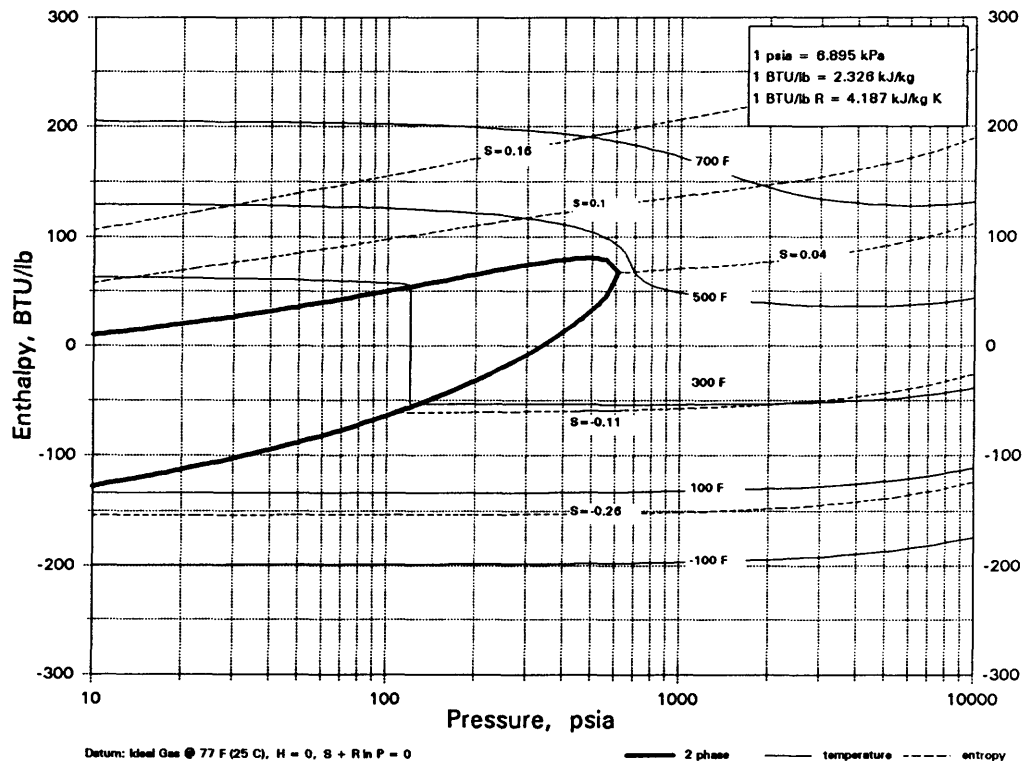
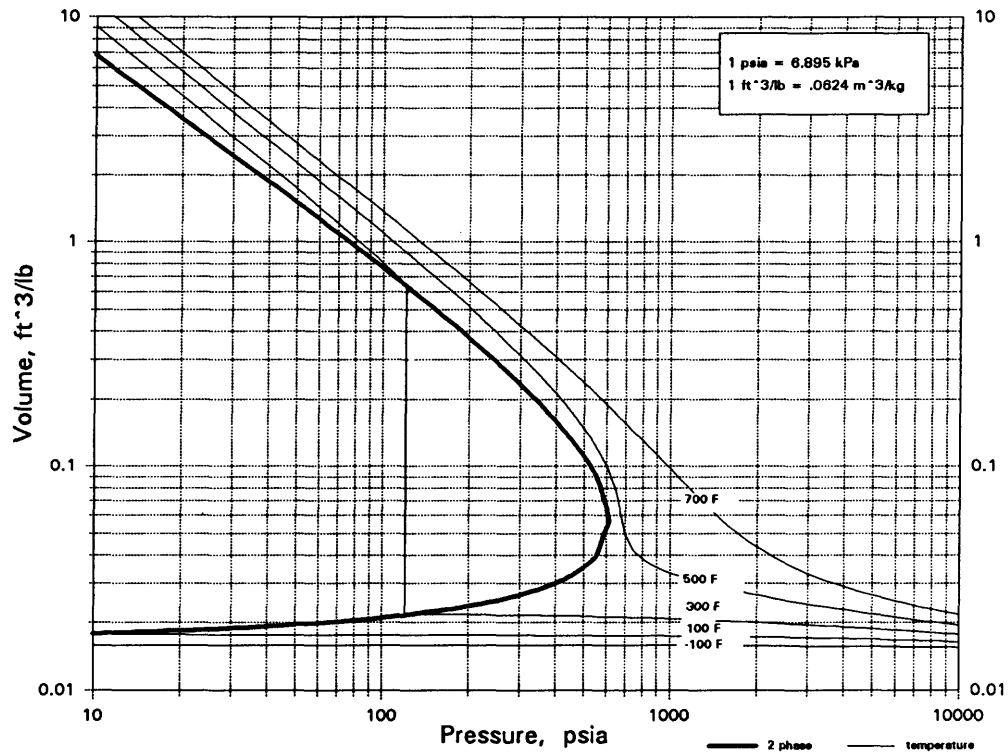


C4H4S
THIOPHENE



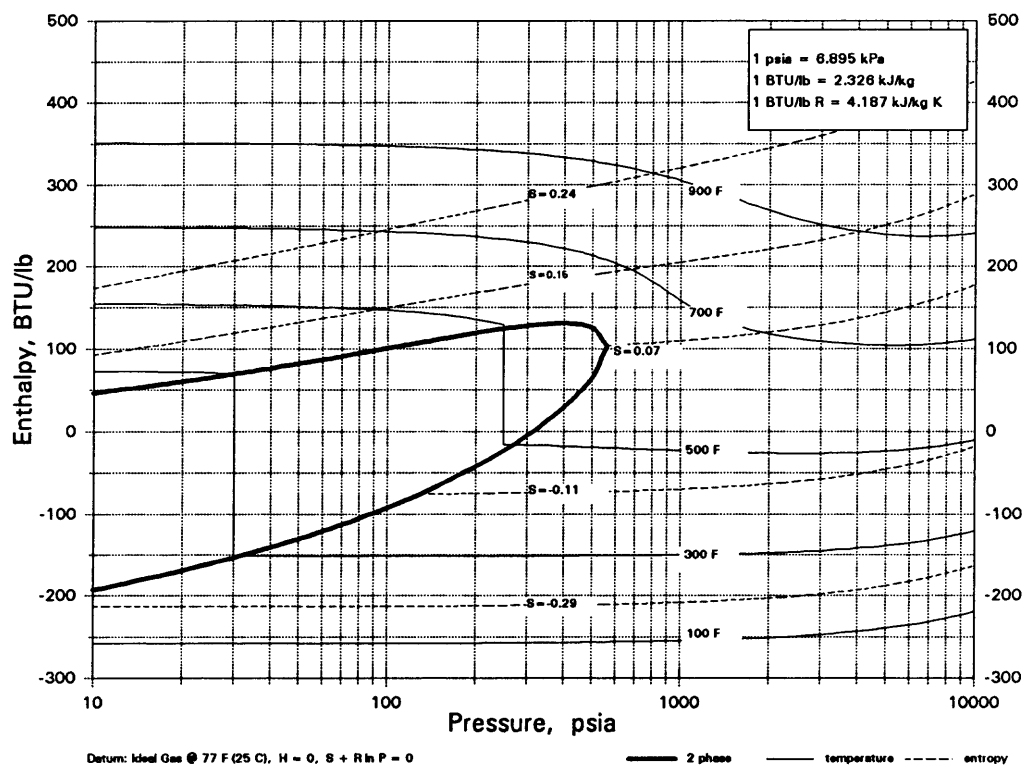
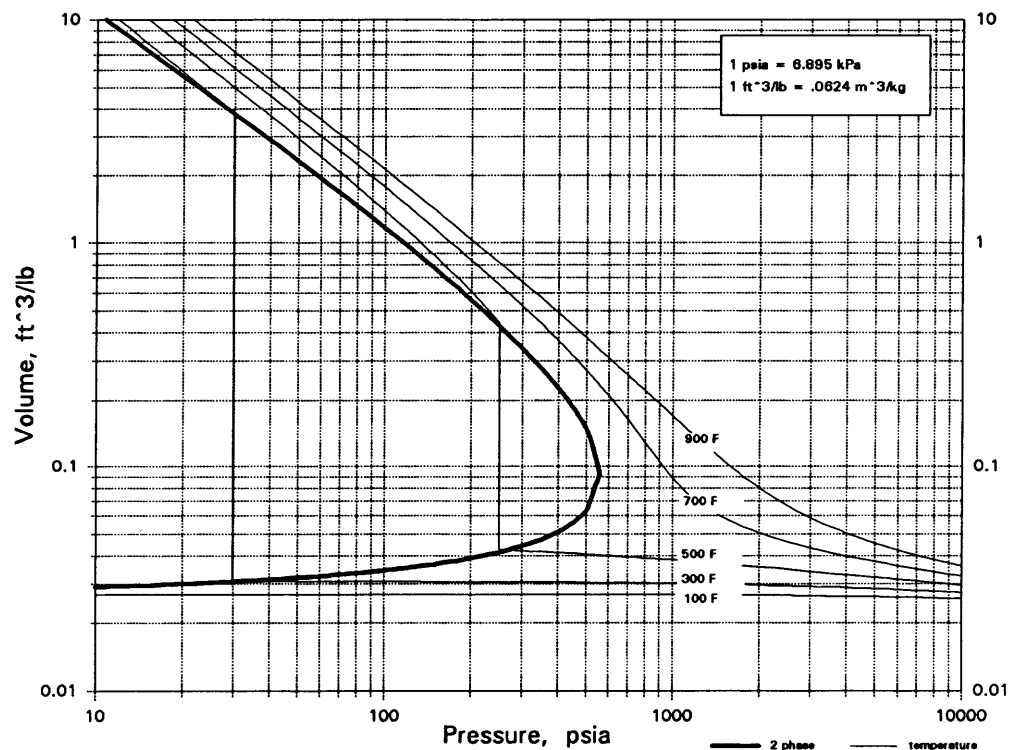
C4H5Cl

CHLOROPRENE



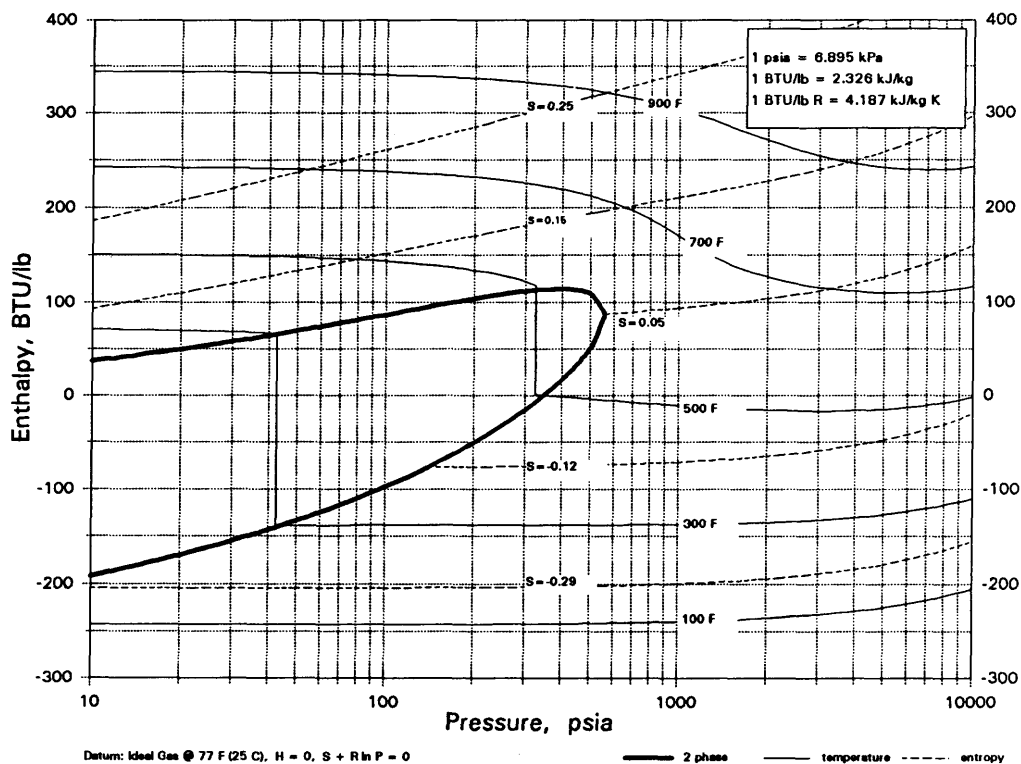
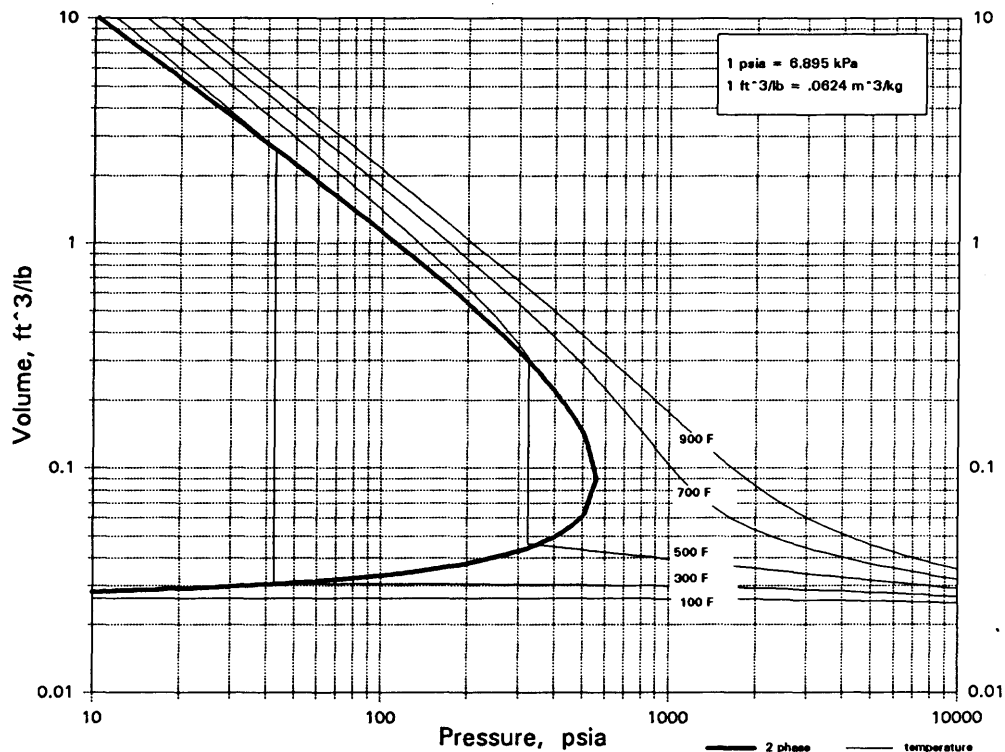
C4H5N

trans-CROTONITRILE



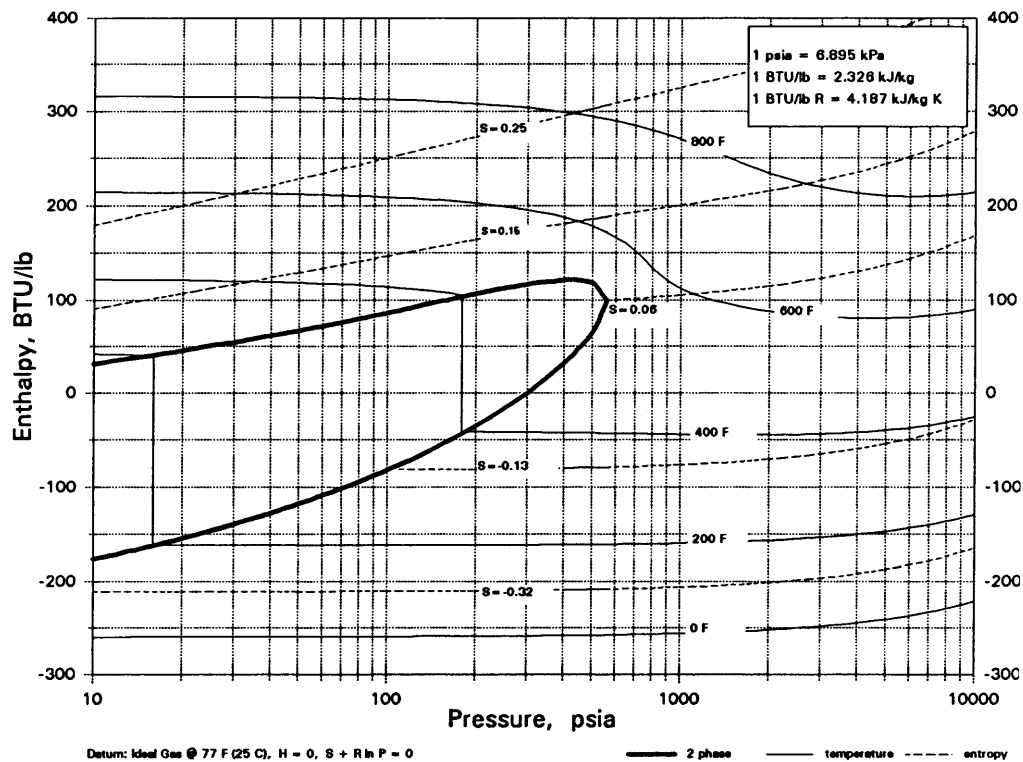
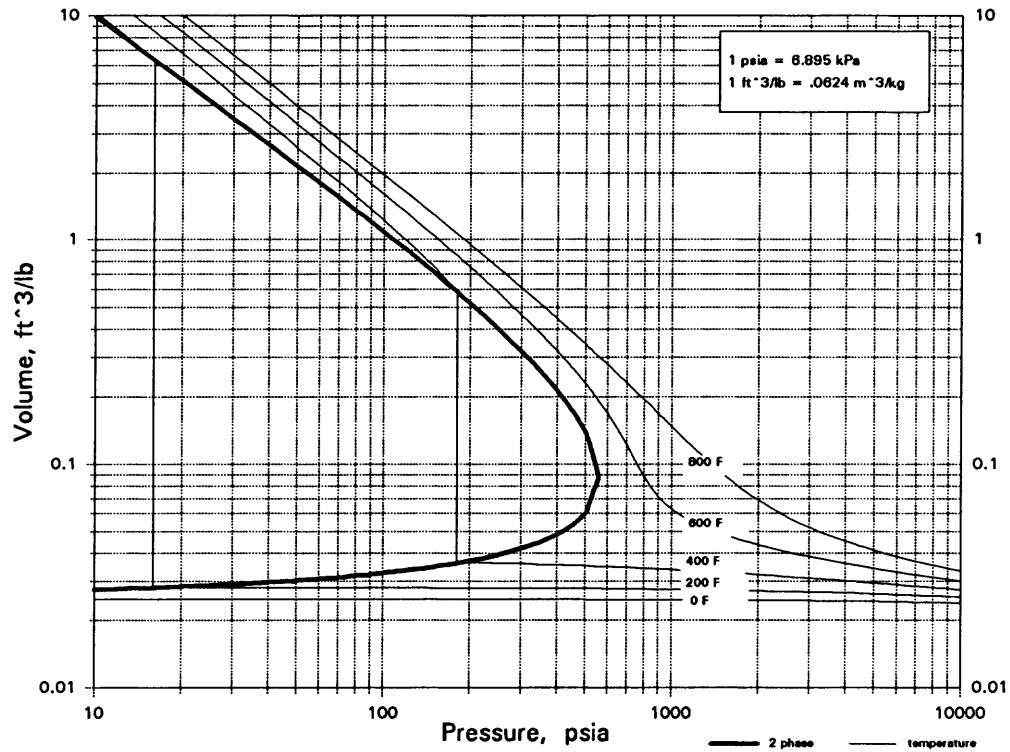
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cis-CROTONITRILE



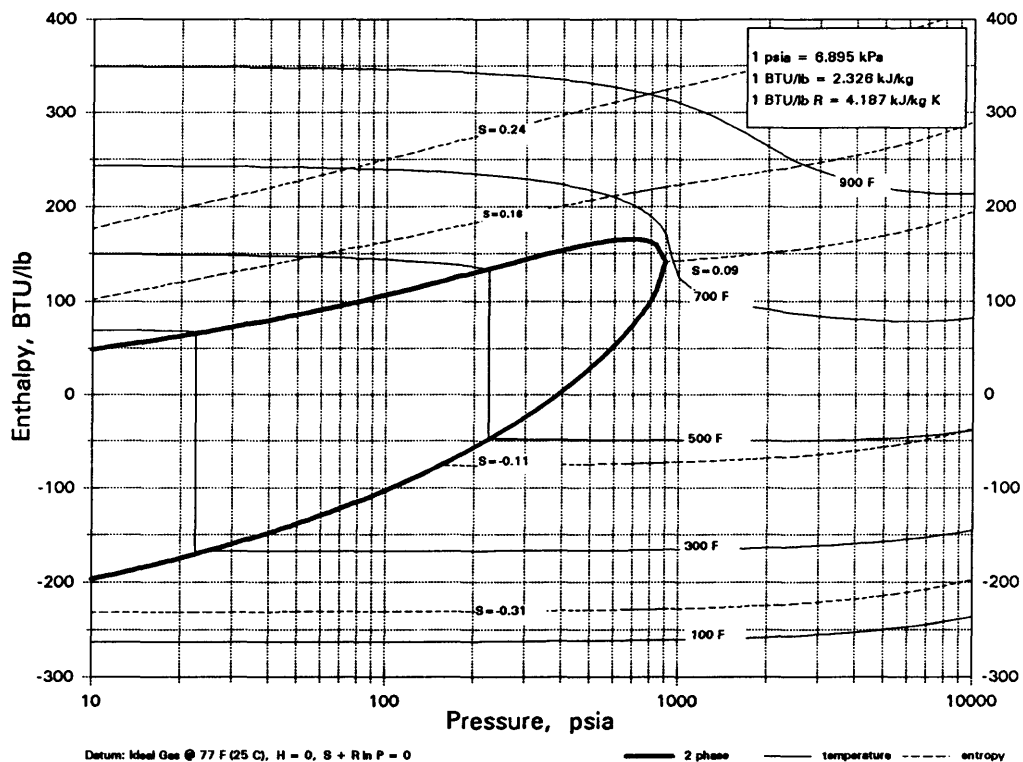
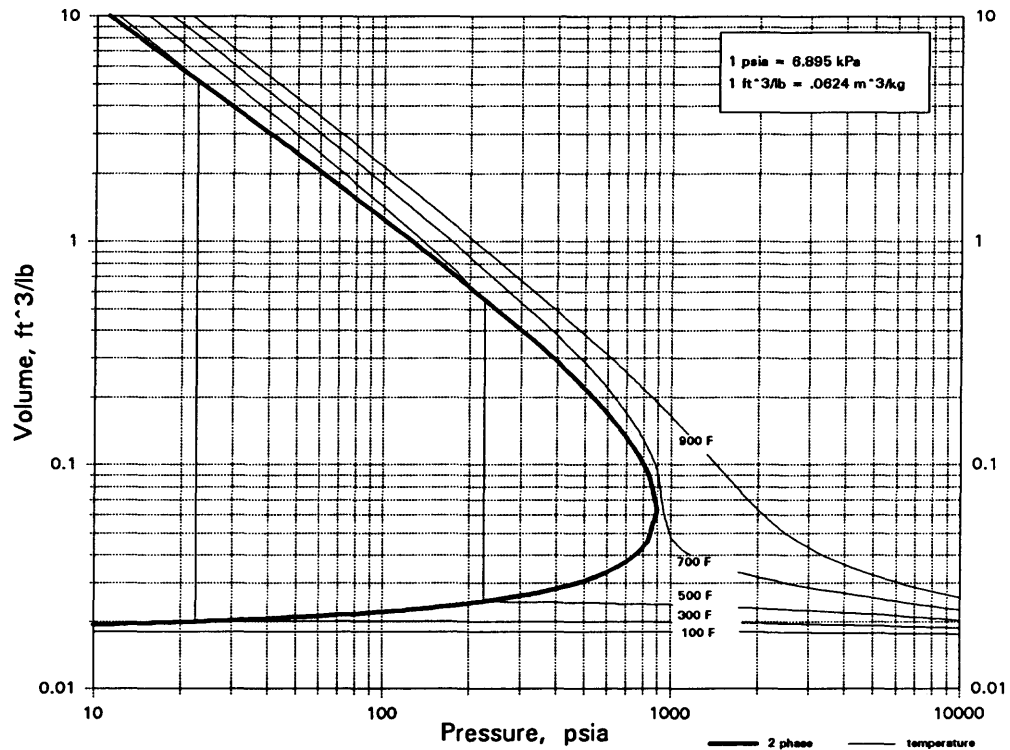
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METHACRYLONITRILE

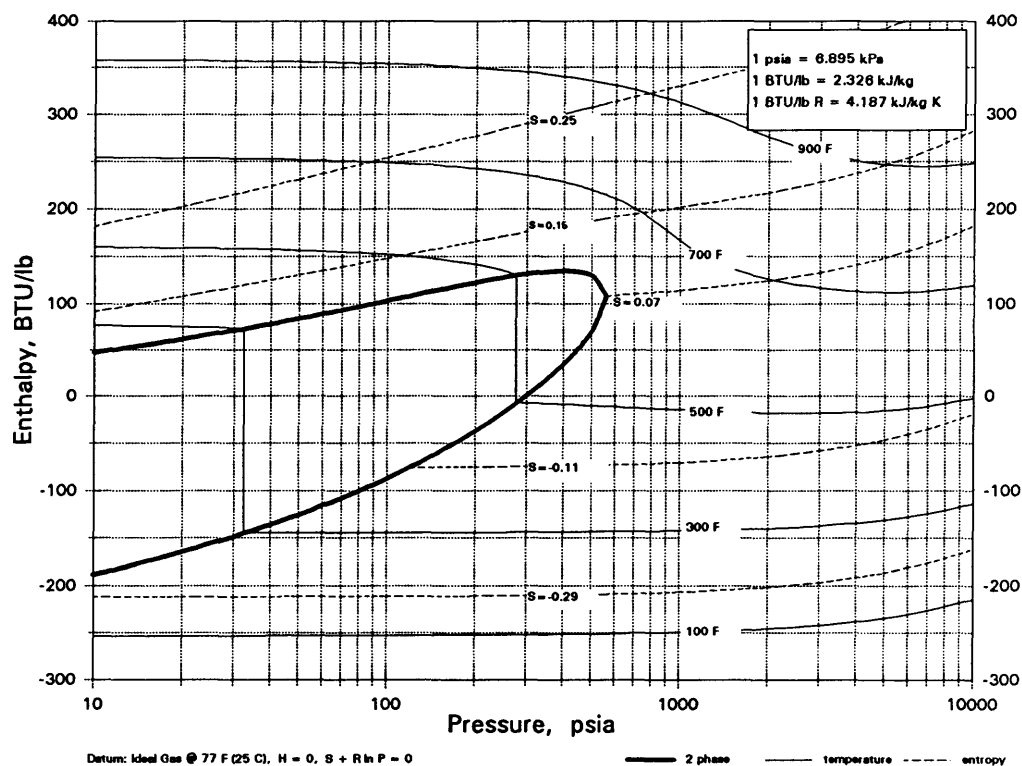
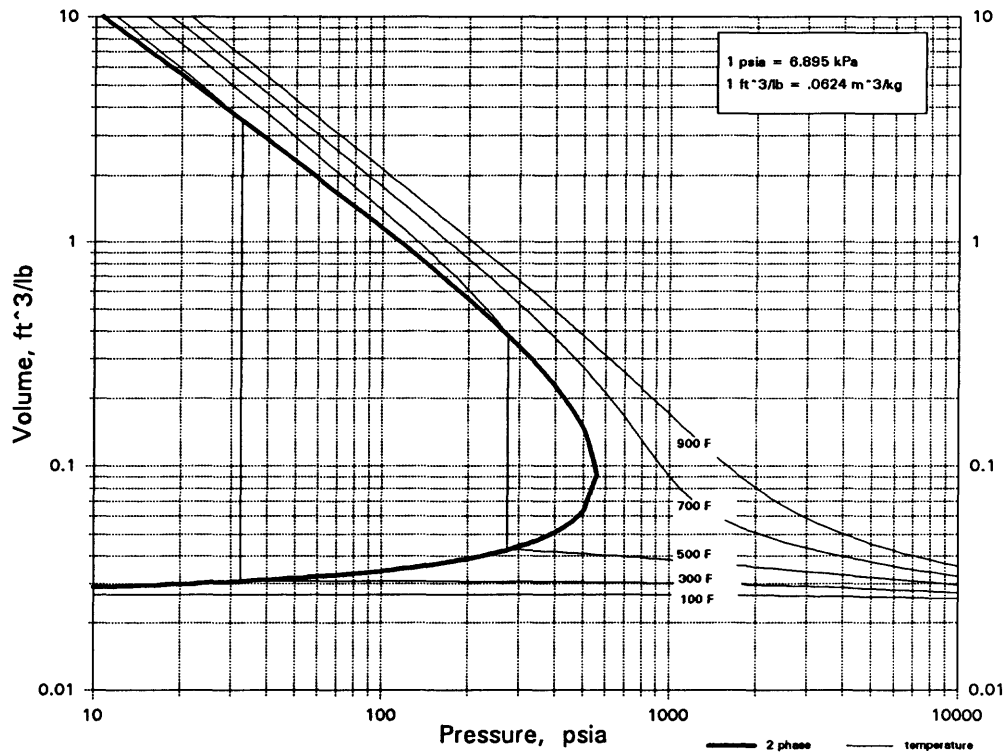


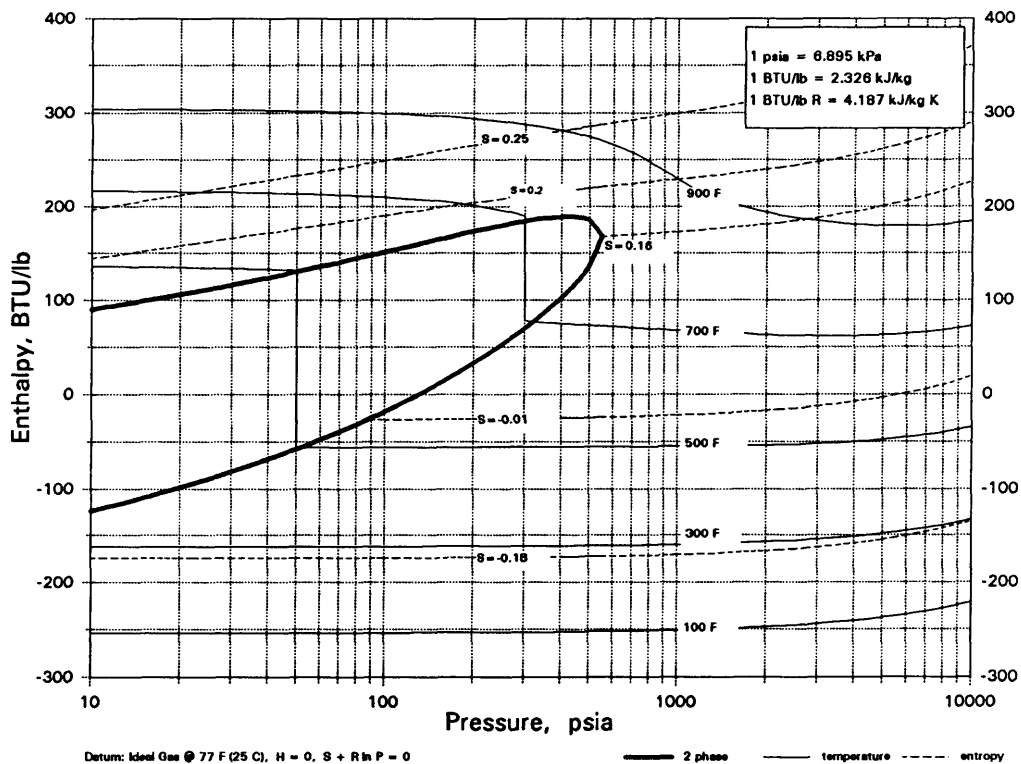
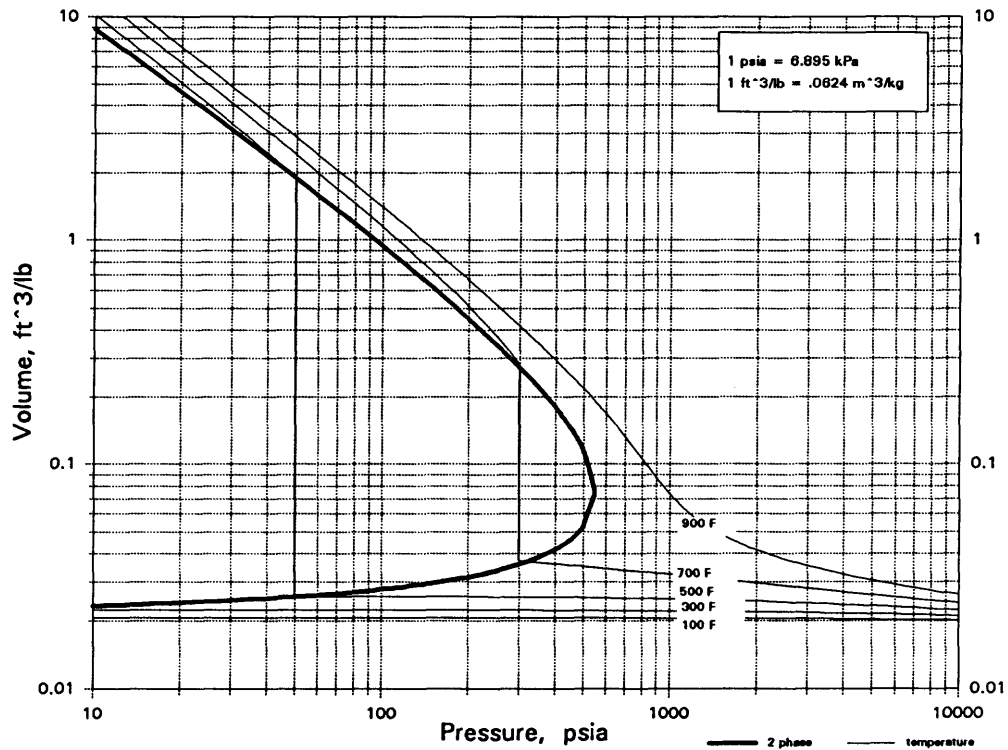
C4H5N

PYRROLE

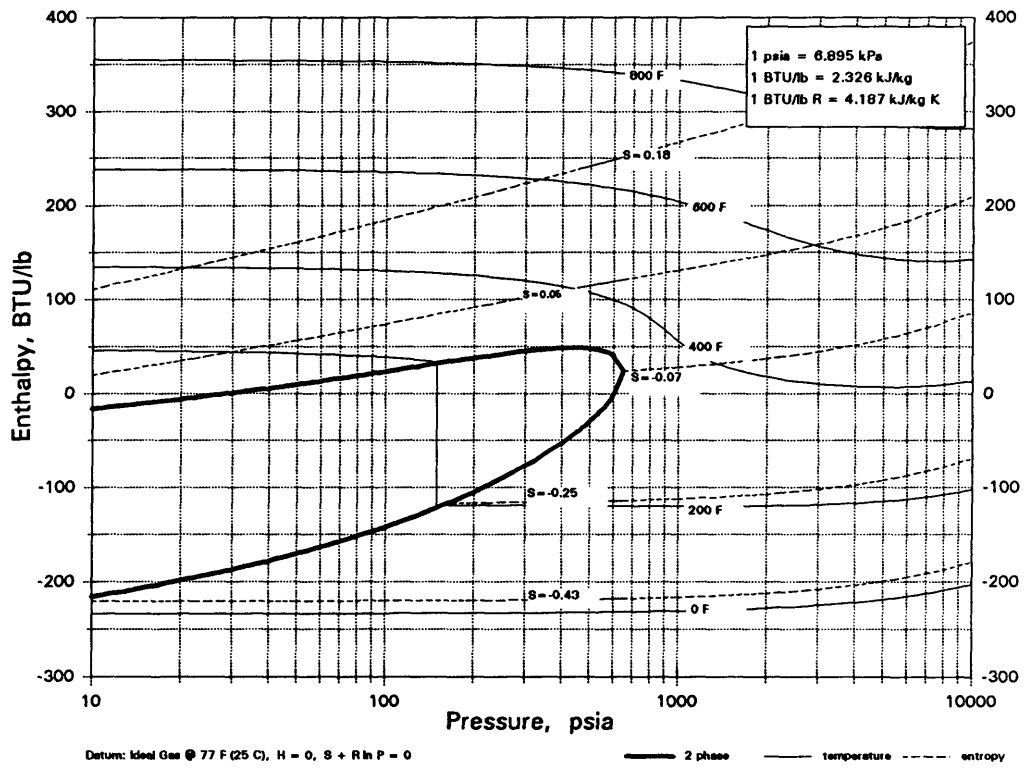
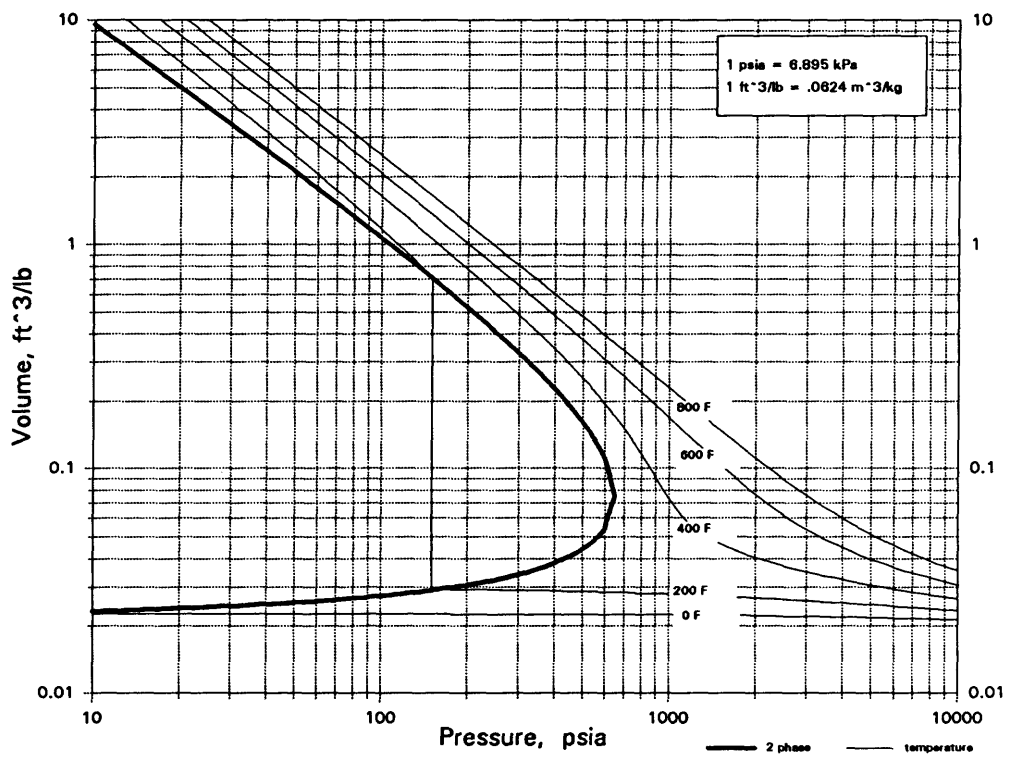


C4H5N
VINYLACETONITRILE

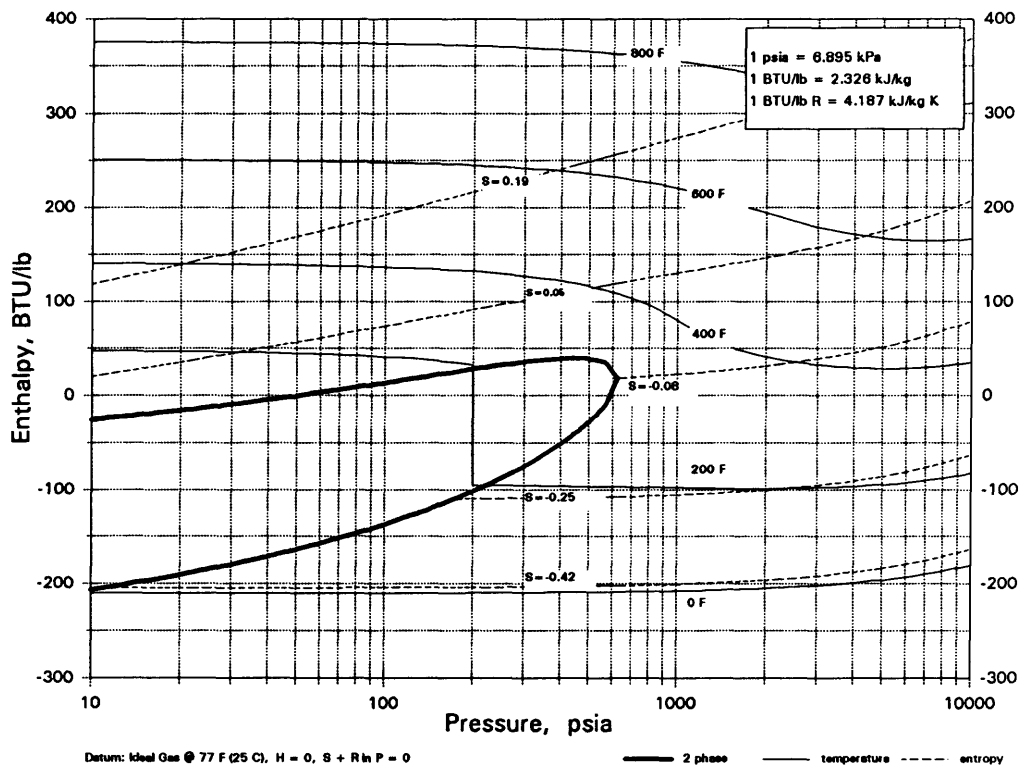
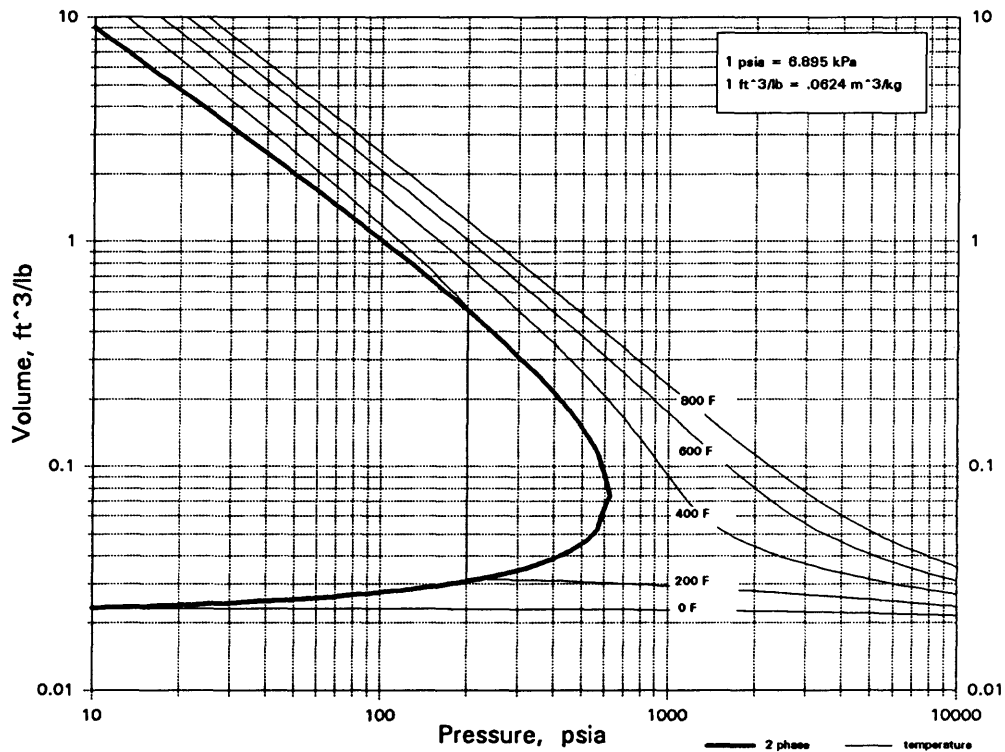


C4H5NO2**METHYL CYANOACETATE**

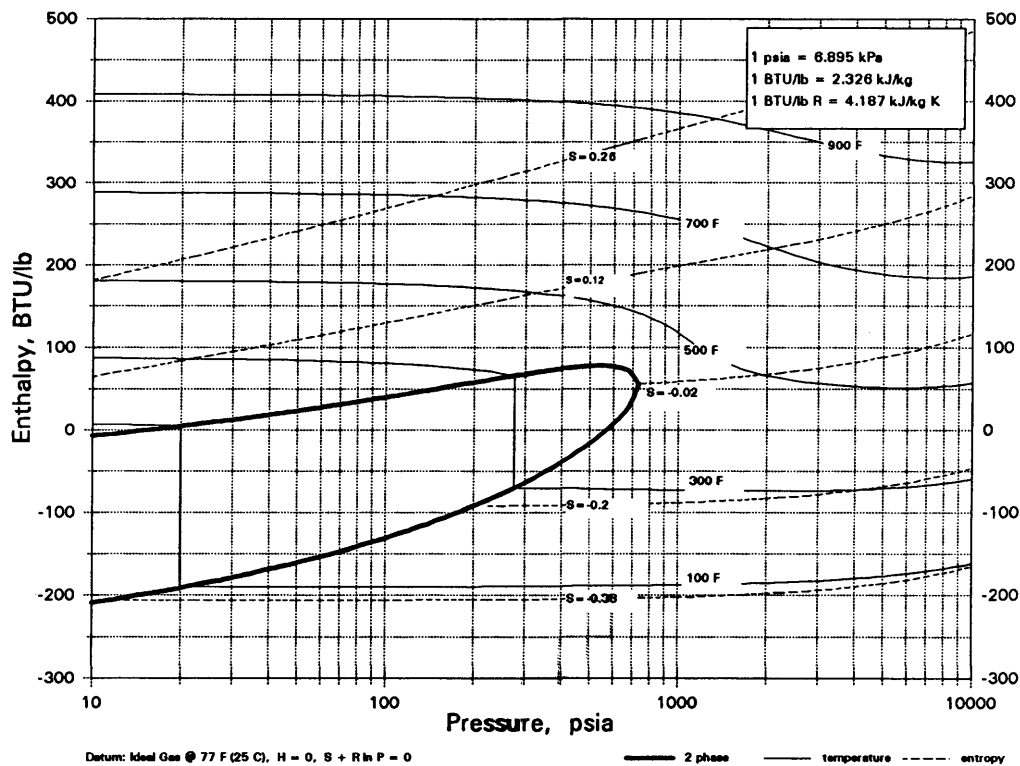
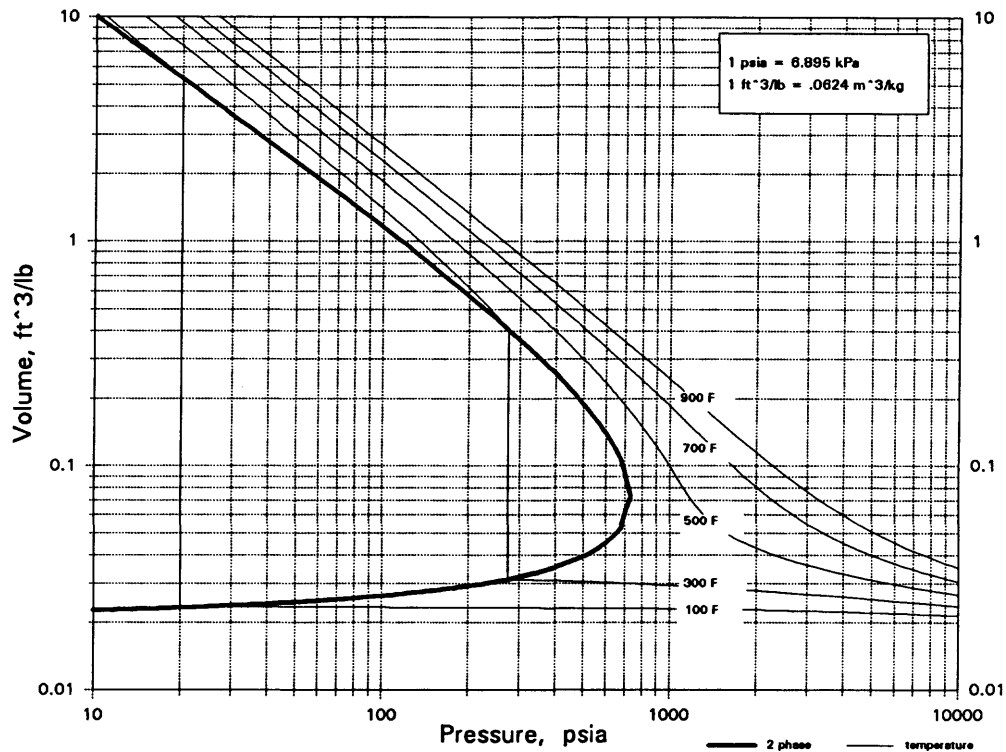
C4H6
1-2-BUTADIENE



C4H6
1-3-BUTADIENE

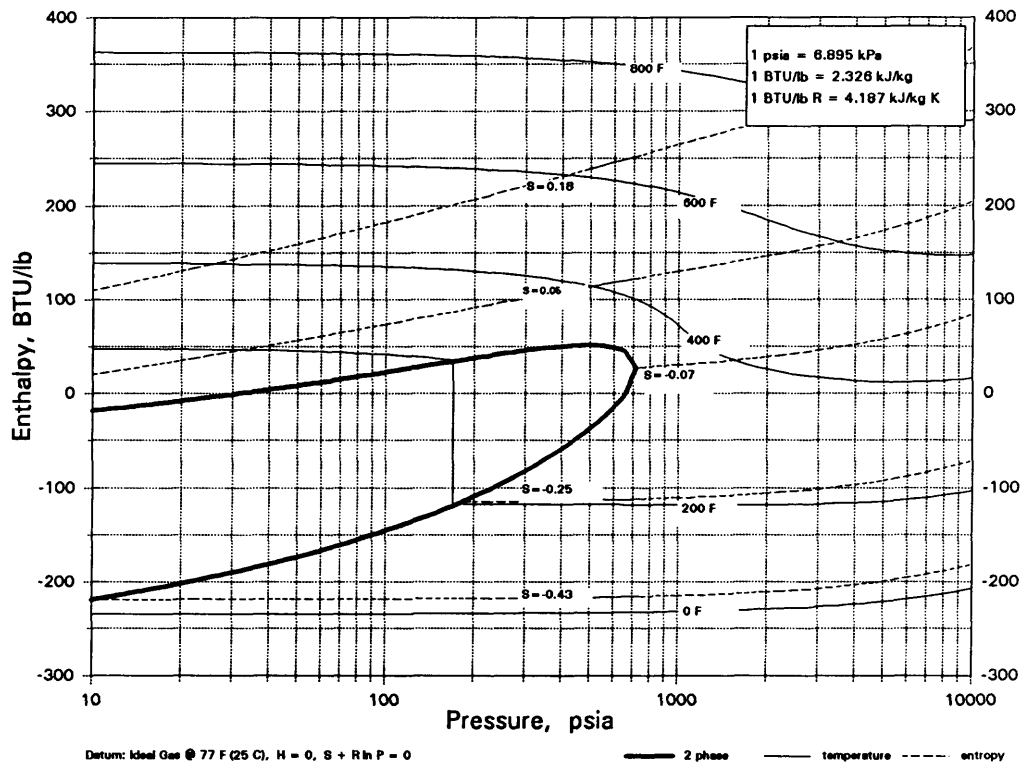
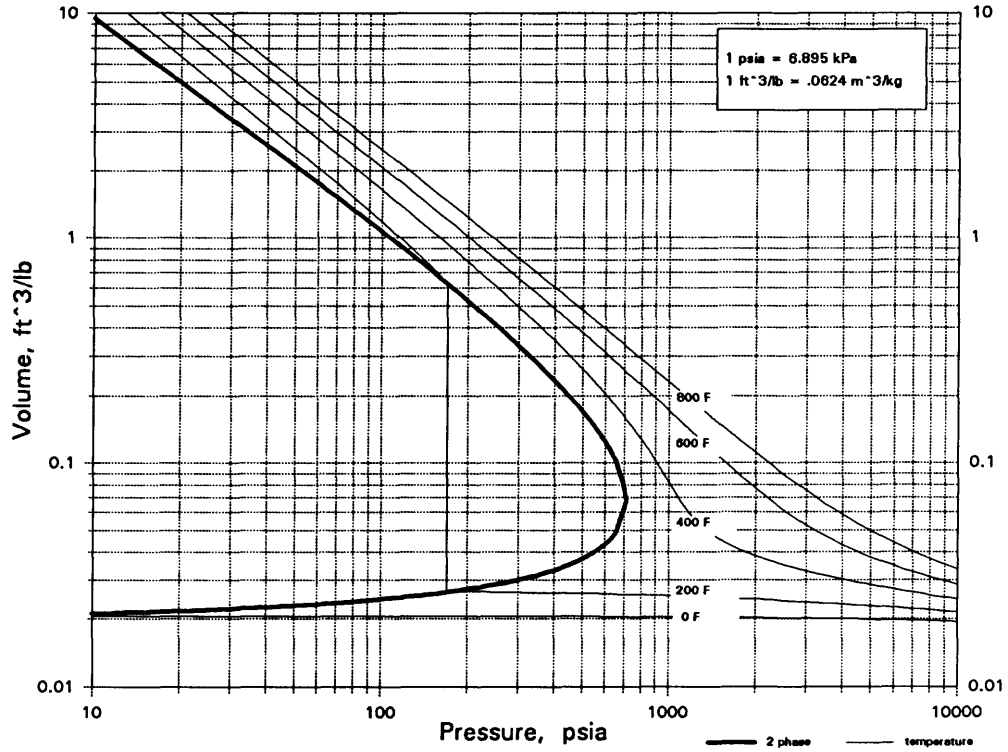


C4H6
DIMETHYLACETYLENE



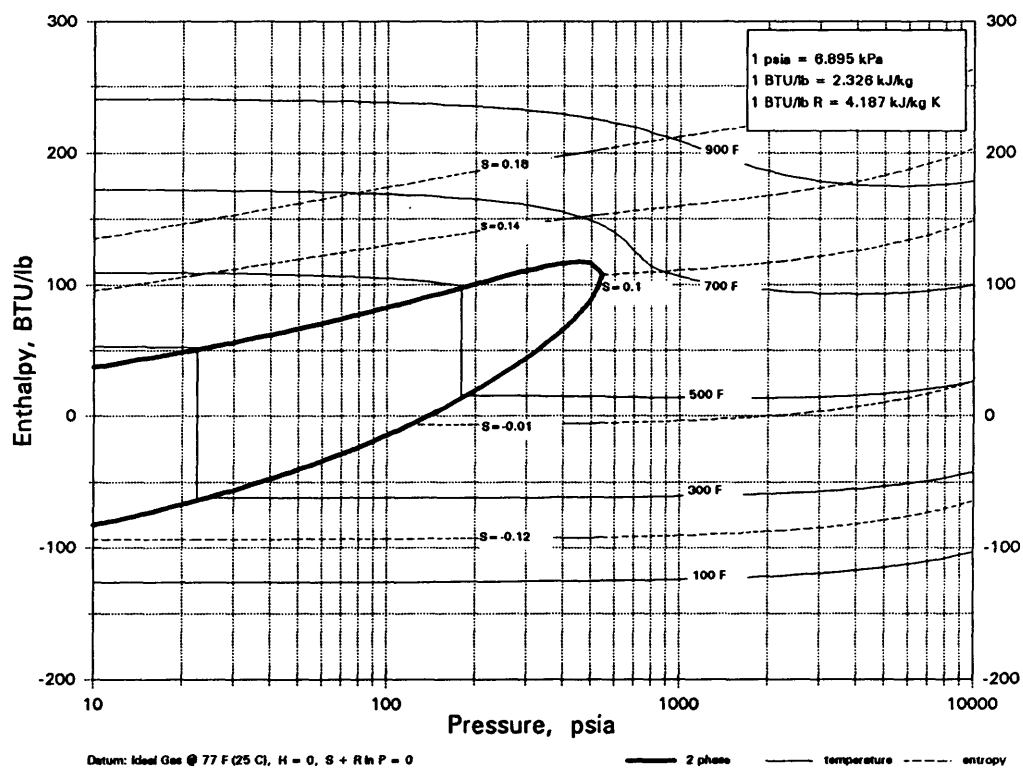
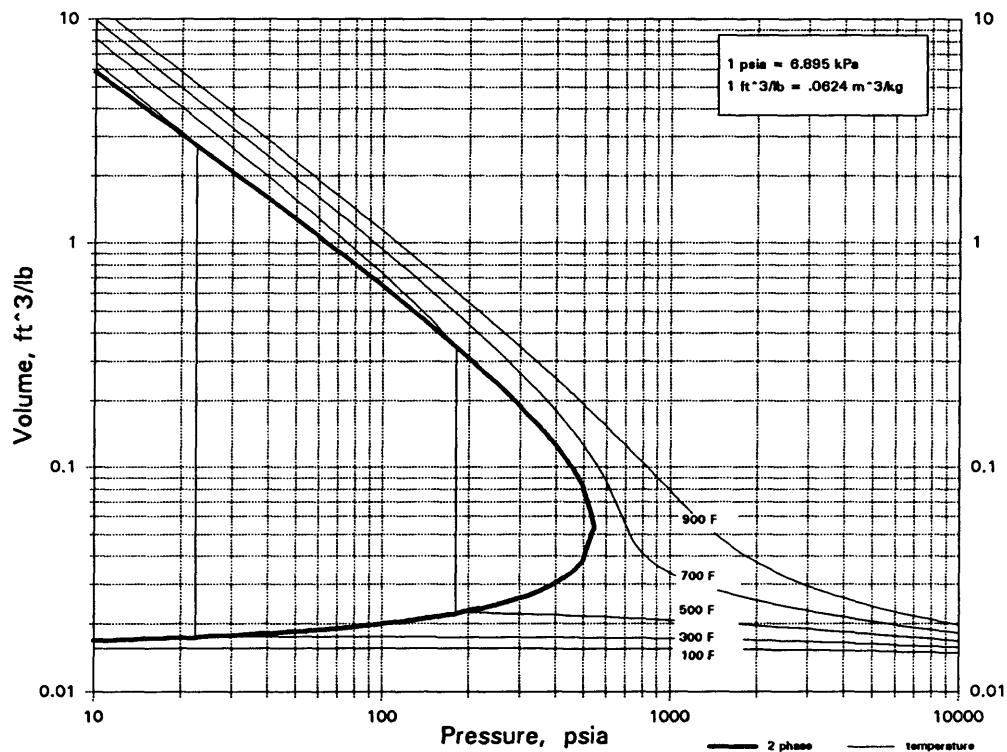
C4H6

ETHYLACETYLENE

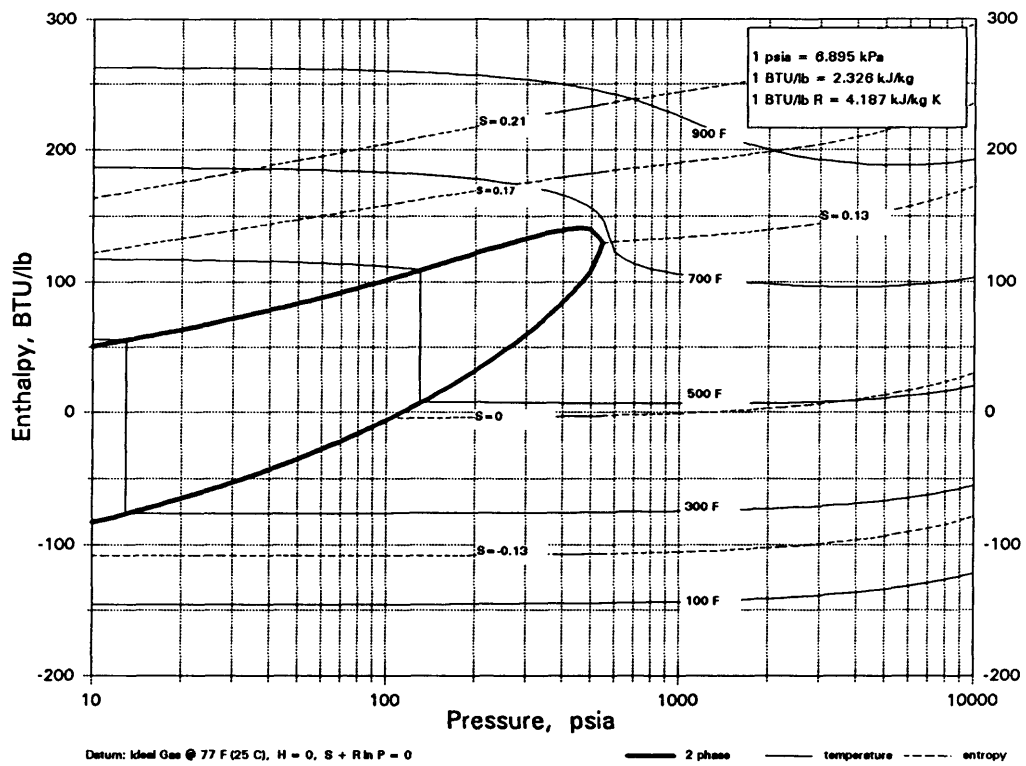
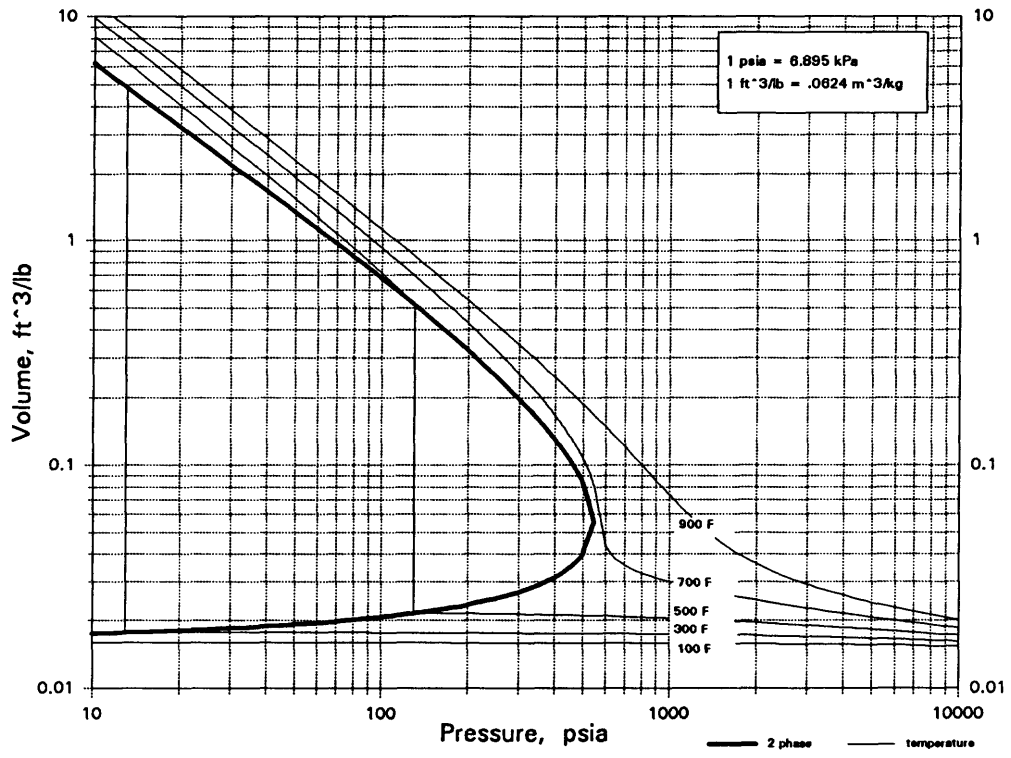


C₄H₆Cl₂

1-3-DICHLORO-trans-2-BUTENE

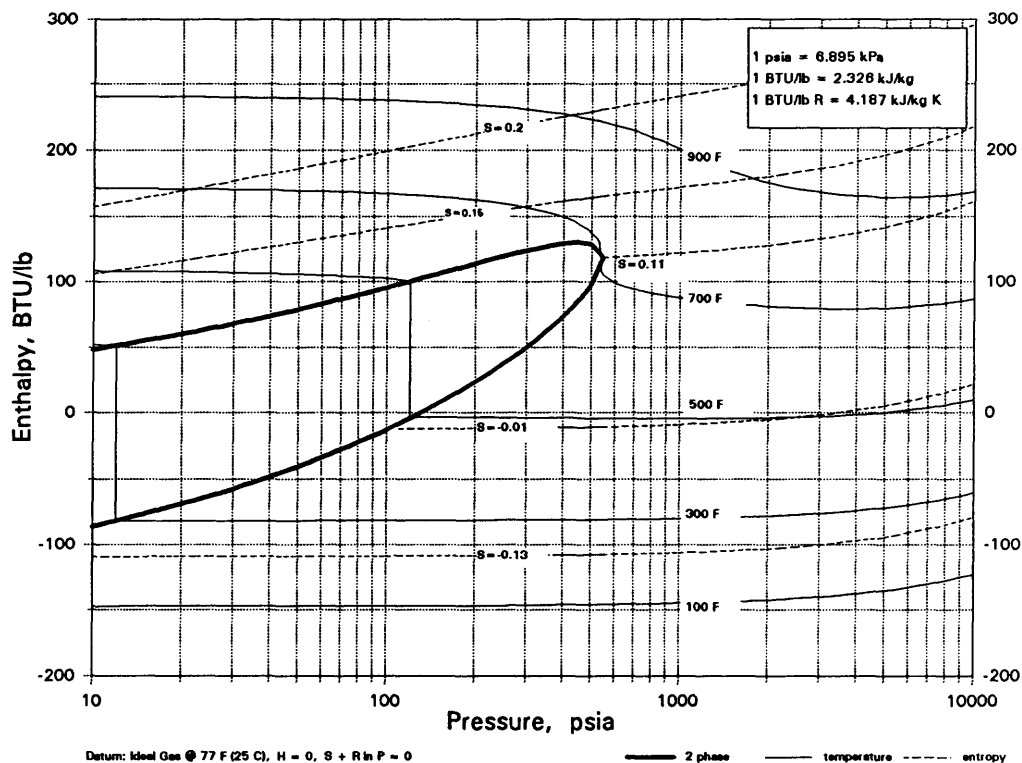
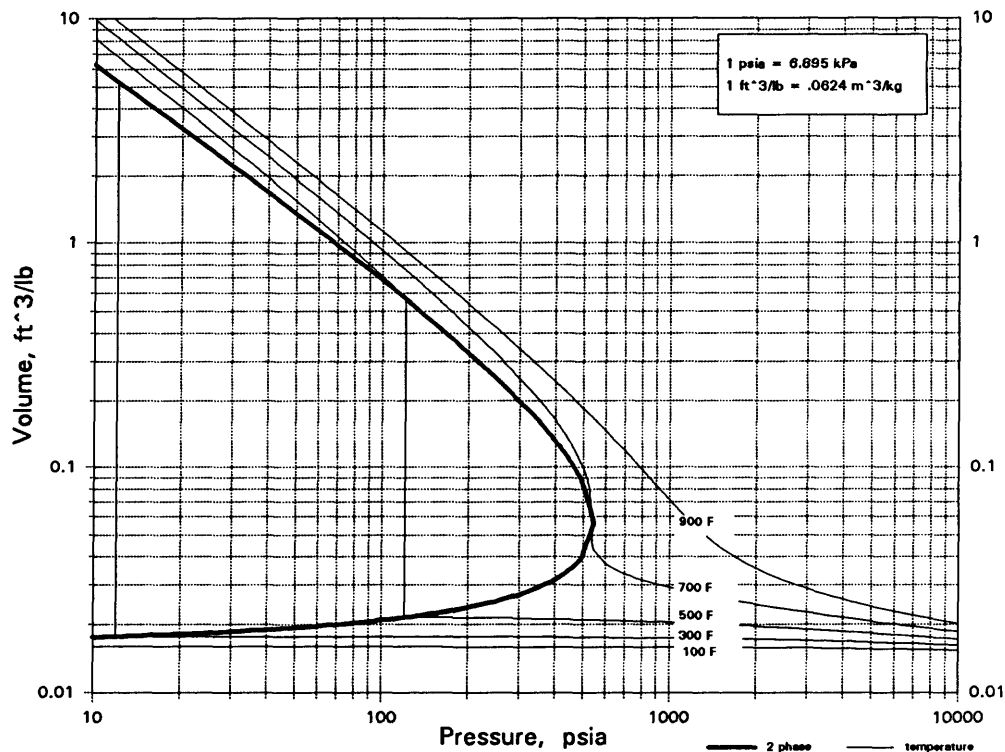


C4H6Cl2
1-4-DICHLORO-cis-2-BUTENE

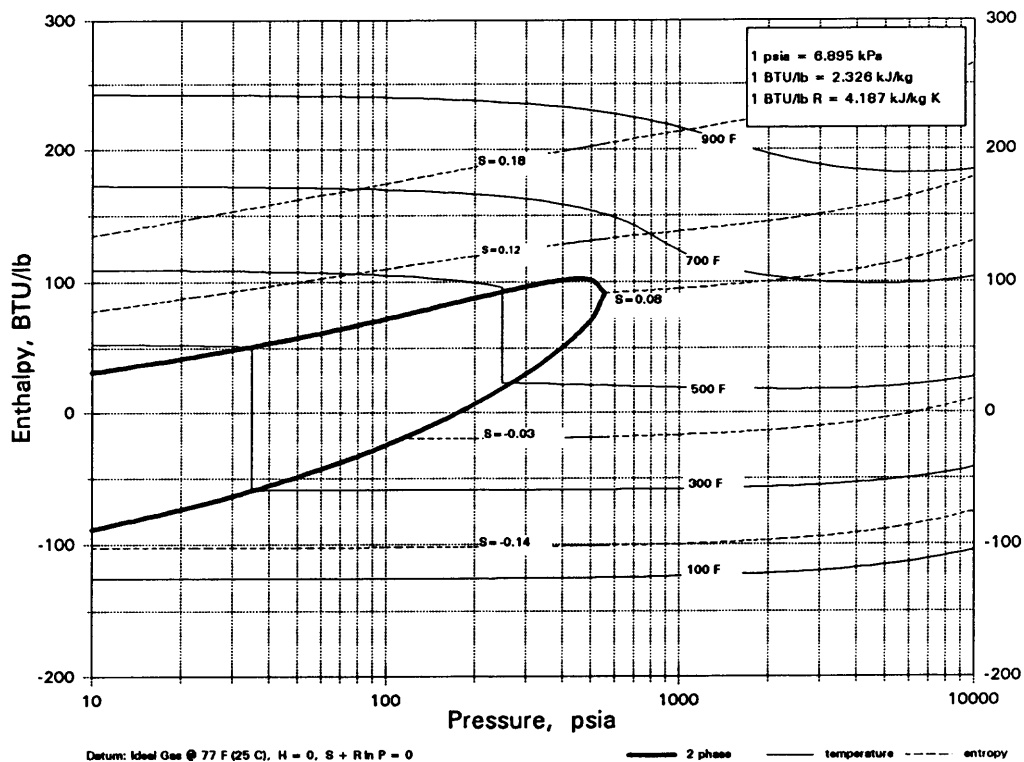
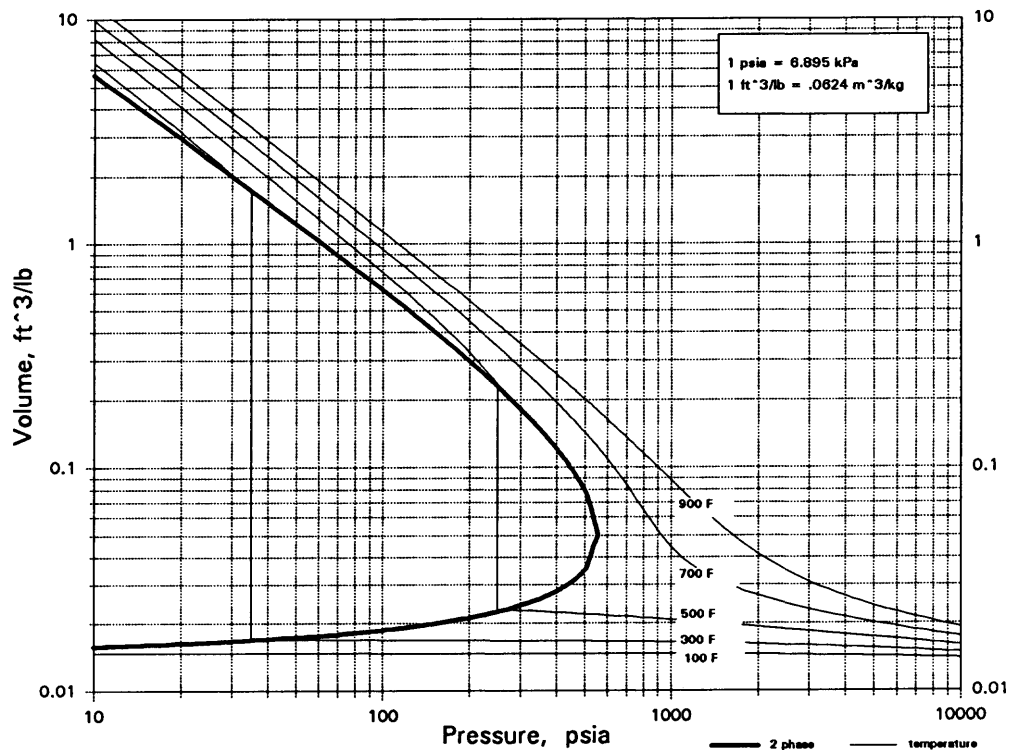


C4H6Cl2

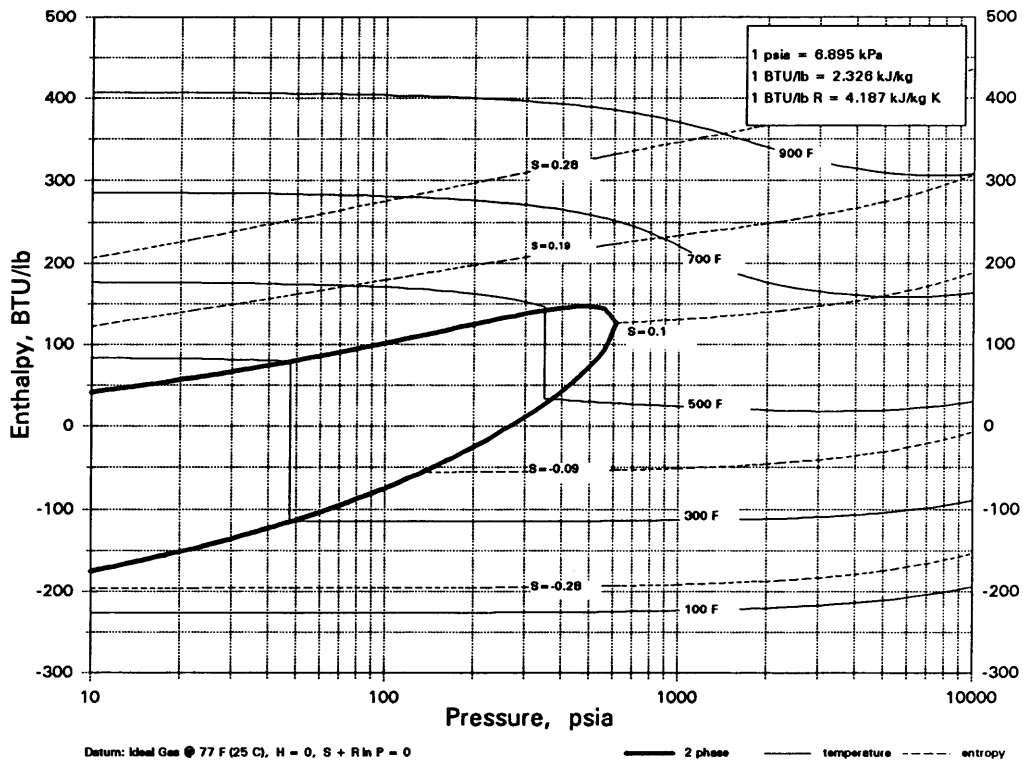
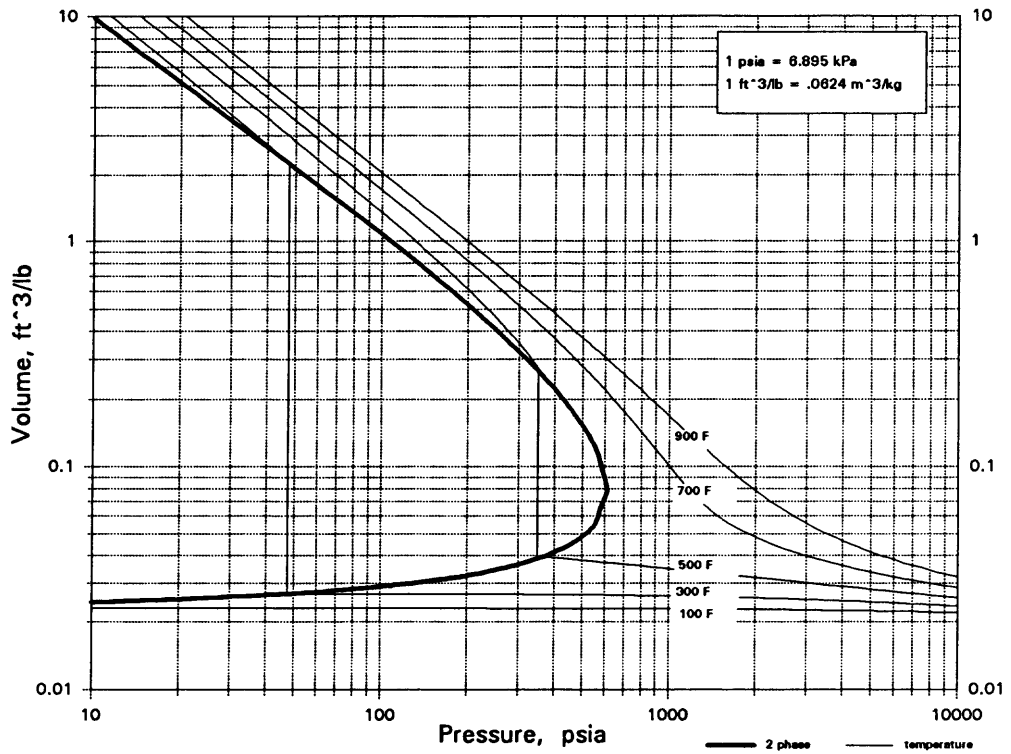
1-4-DICHLORO-trans-2-BUTENE



C4H6Cl2
3-4-DICHLORO-1-BUTENE

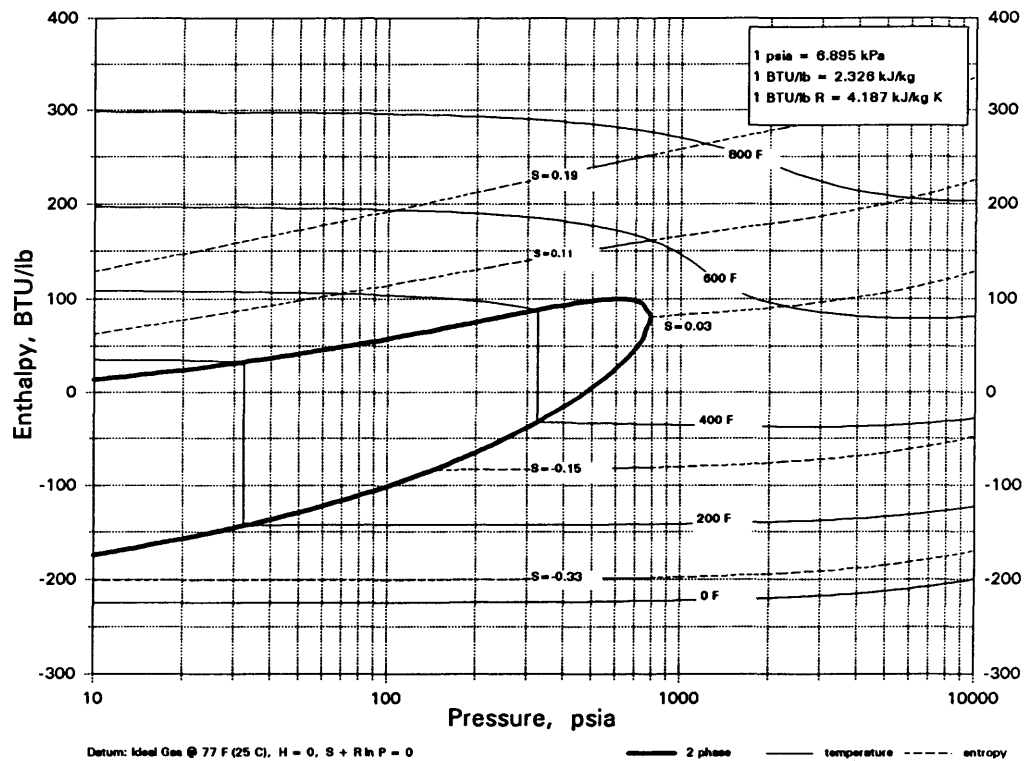
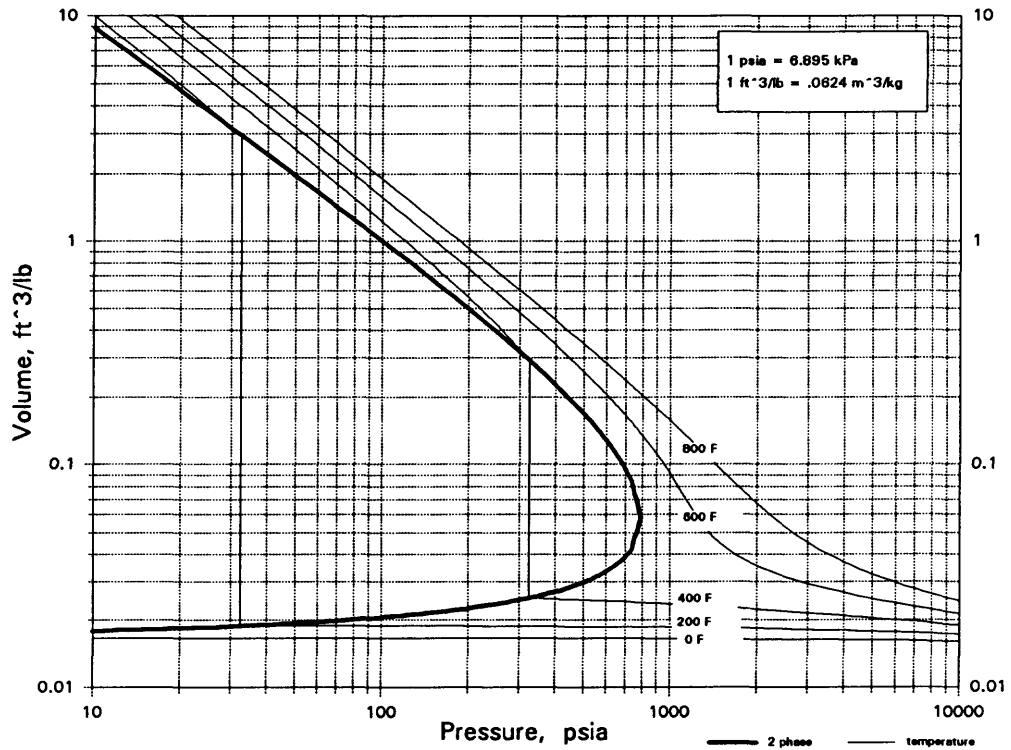


C4H6O
trans-CROTONALDEHYDE



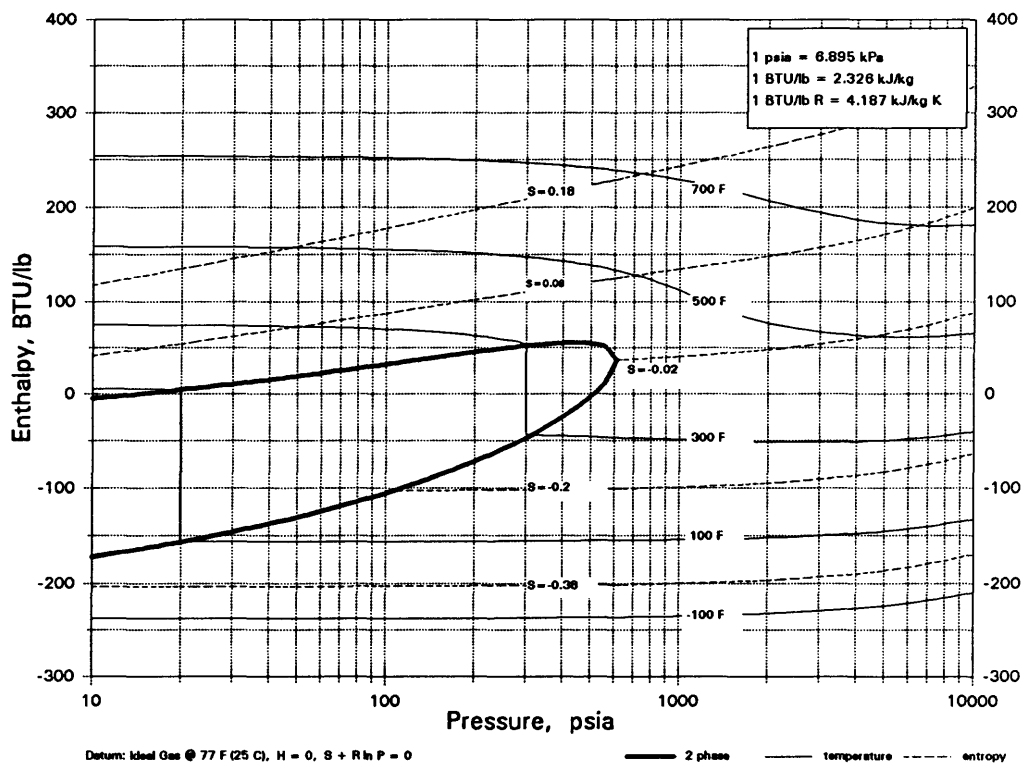
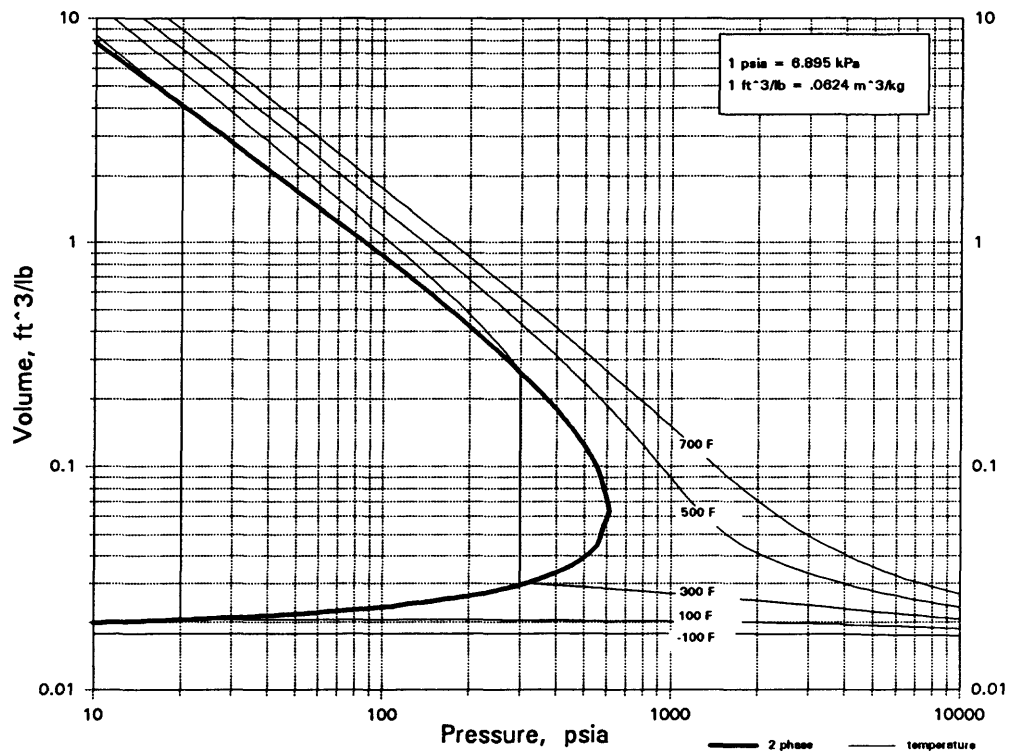
C4H6O

2-5-DIHYDROFURAN

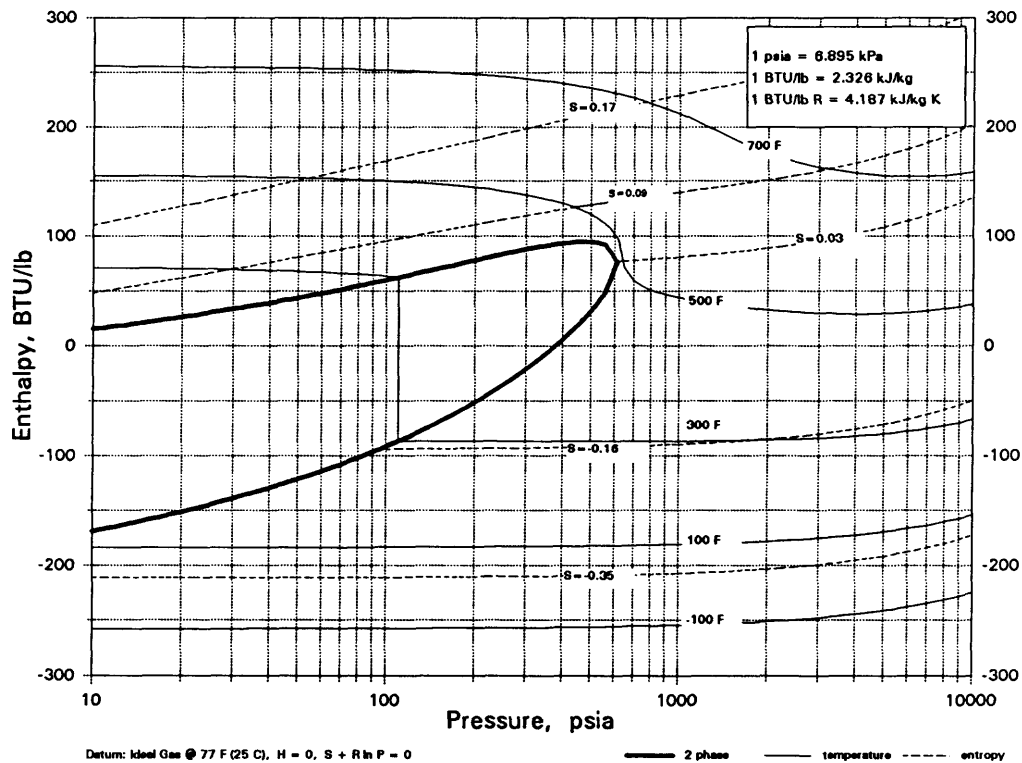
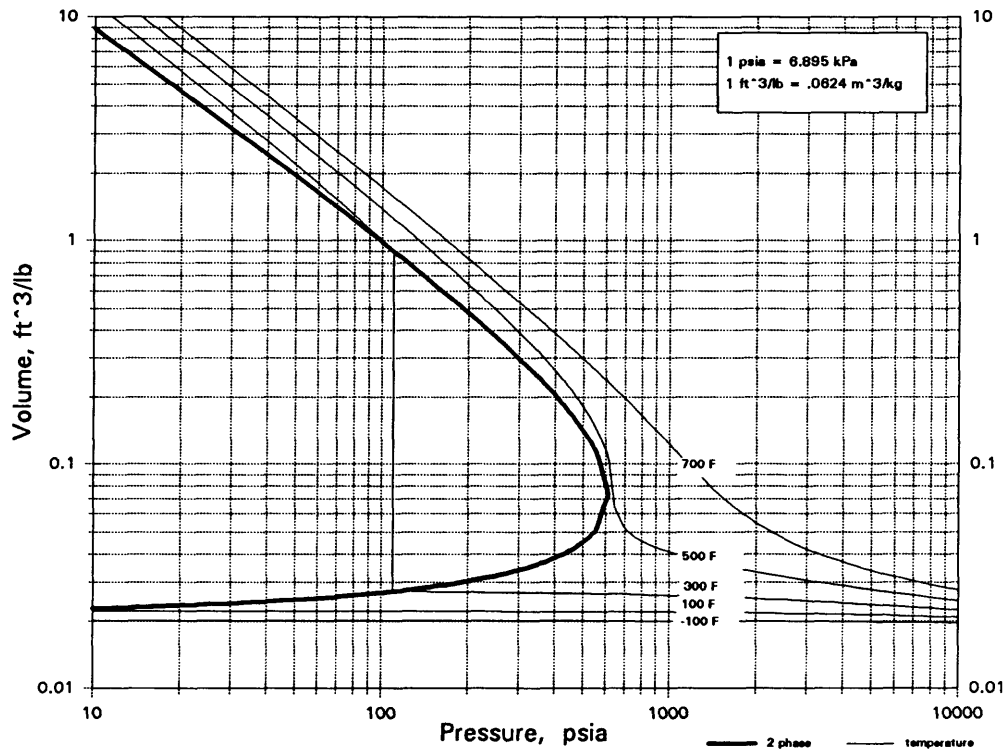


C4H6O

DIVINYL ETHER

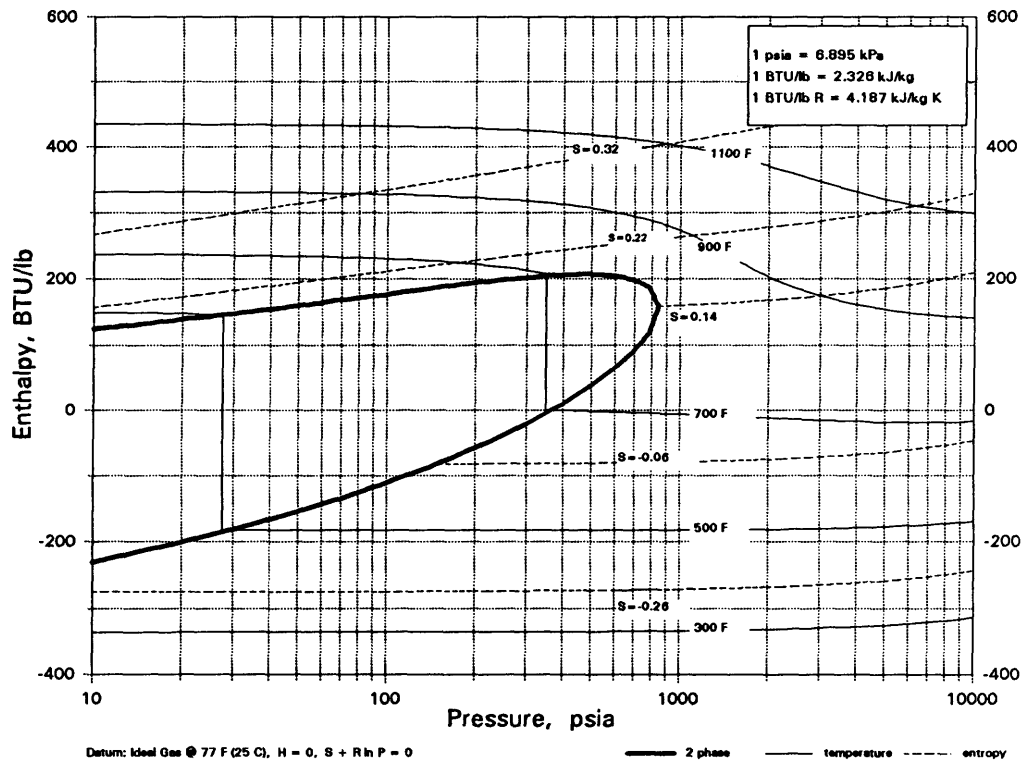
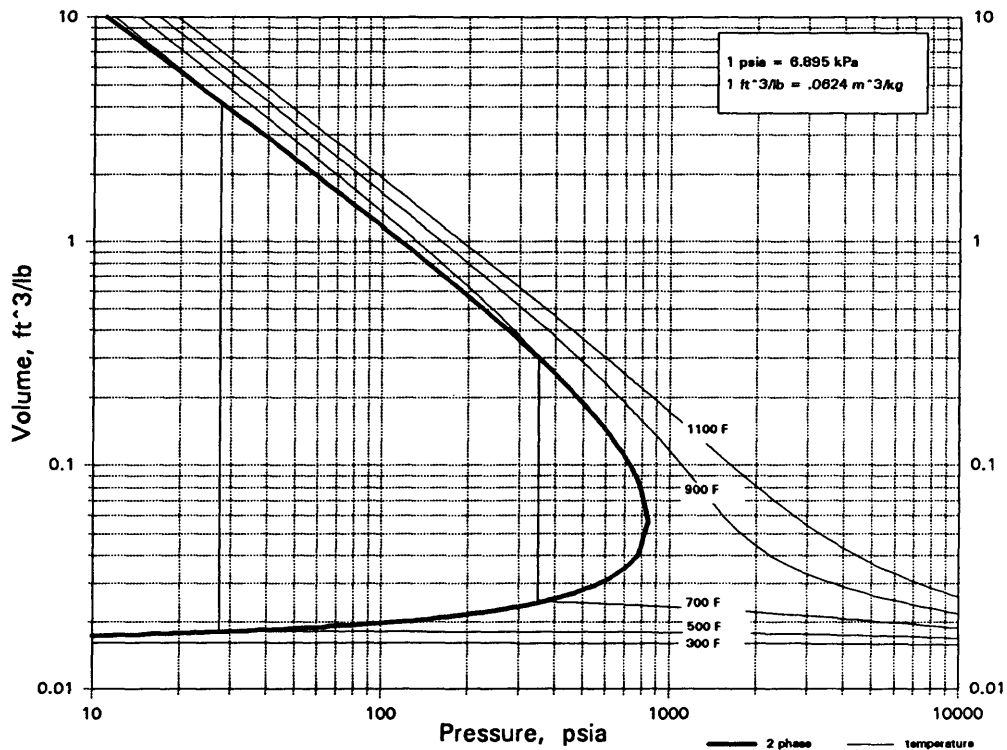


C₄H₆O
METHACROLEIN



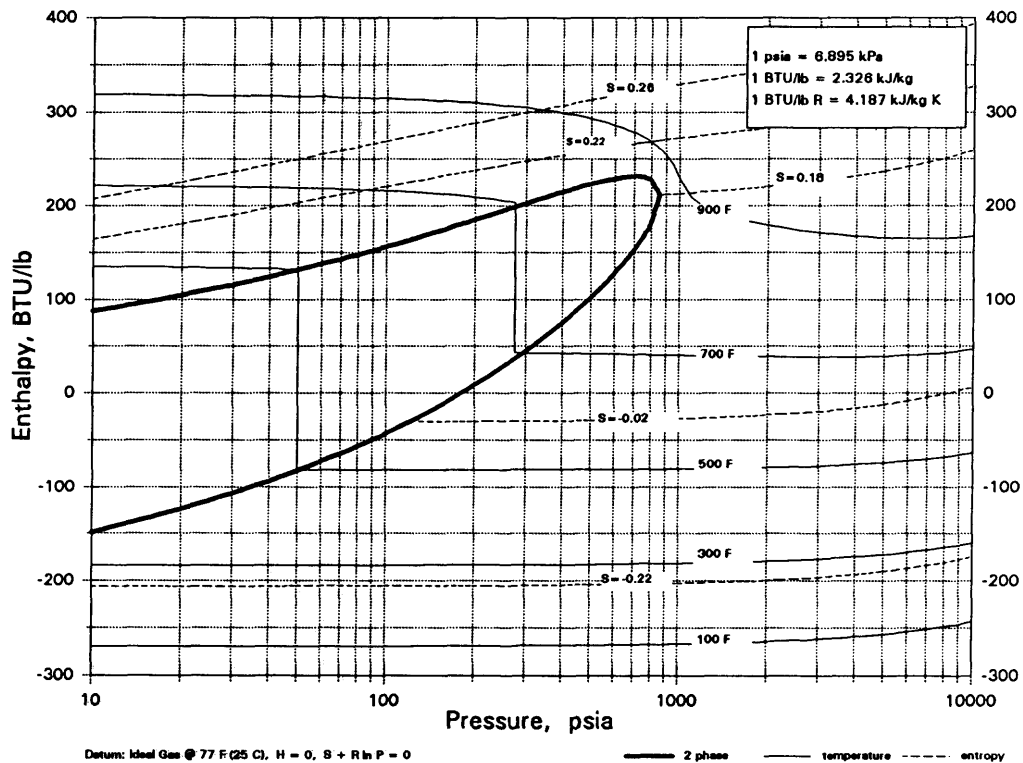
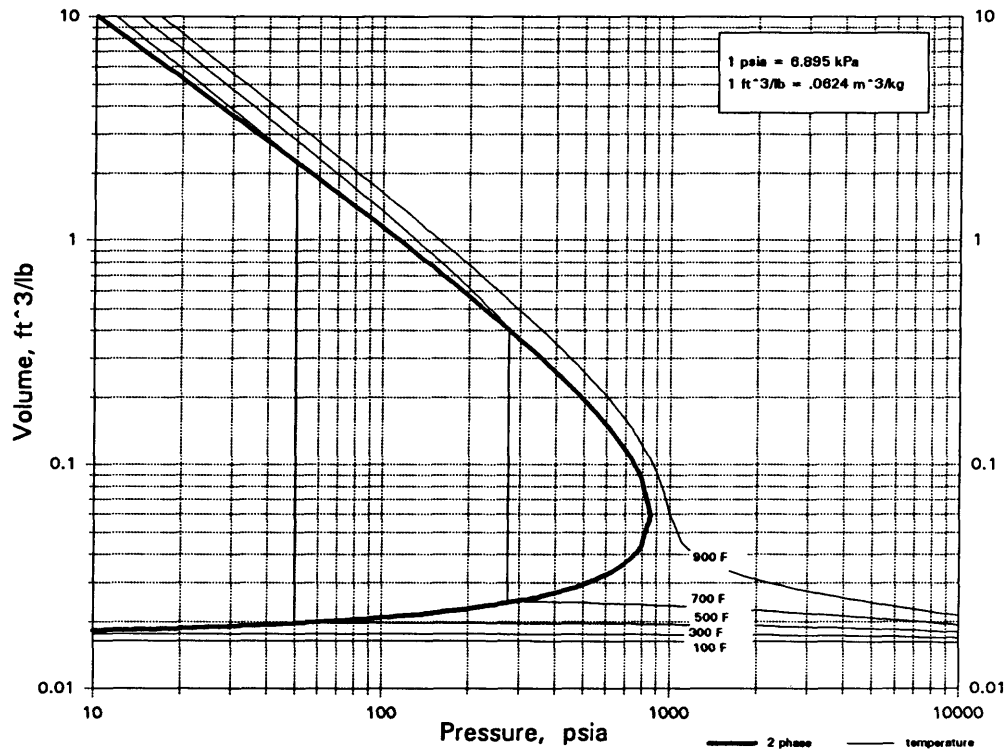
C4H6O2

2-BUTYNE-1-4-DIOL



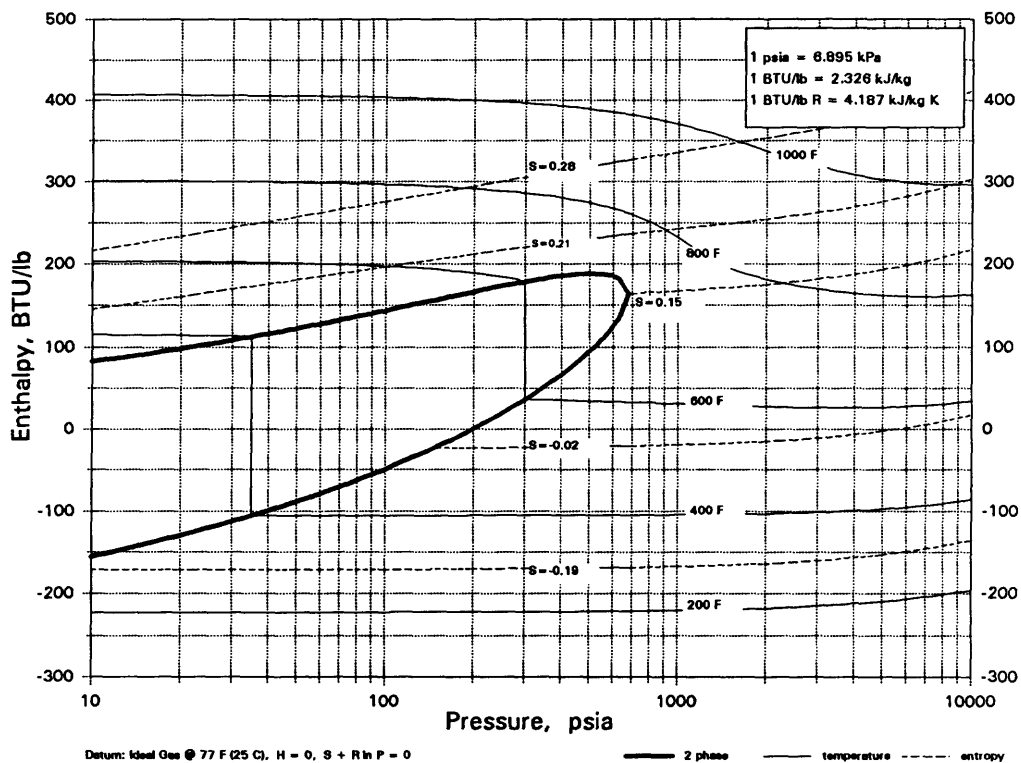
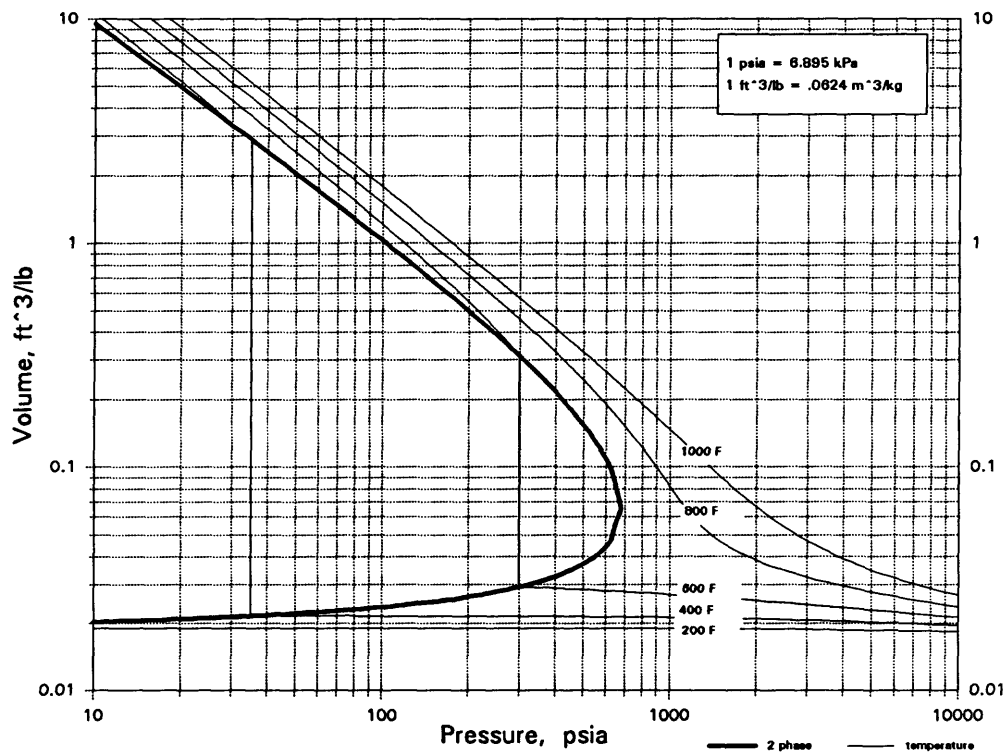
C4H6O2

gamma-BUTYROLACTONE

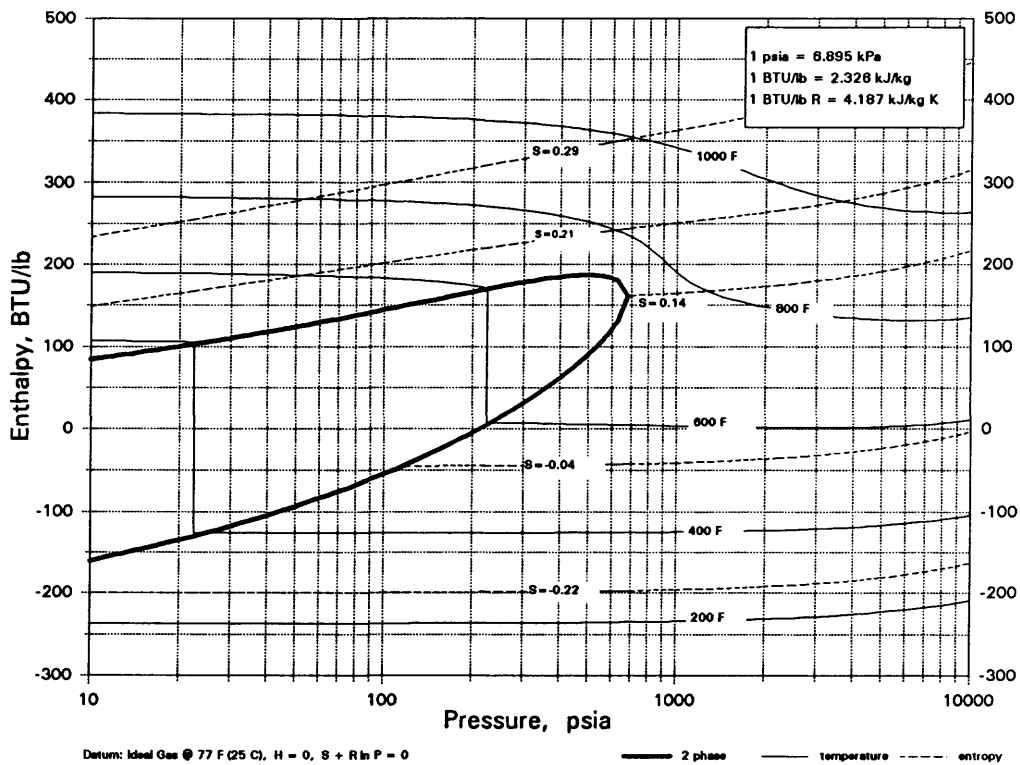
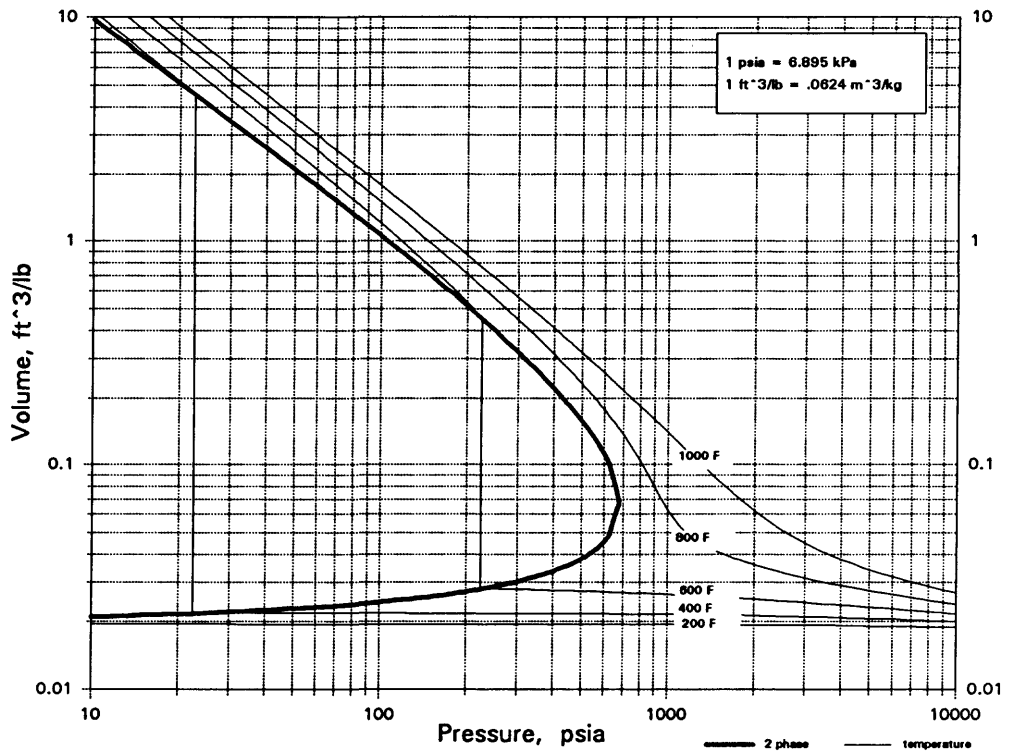


C4H6O2

cis-CROTONIC ACID

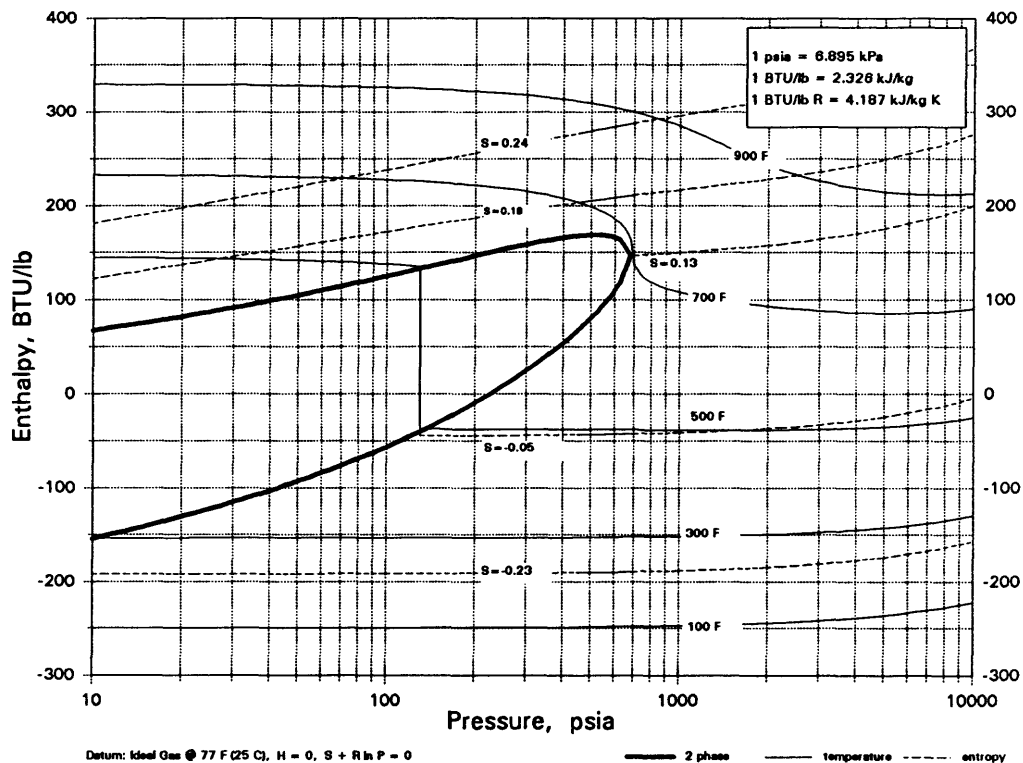
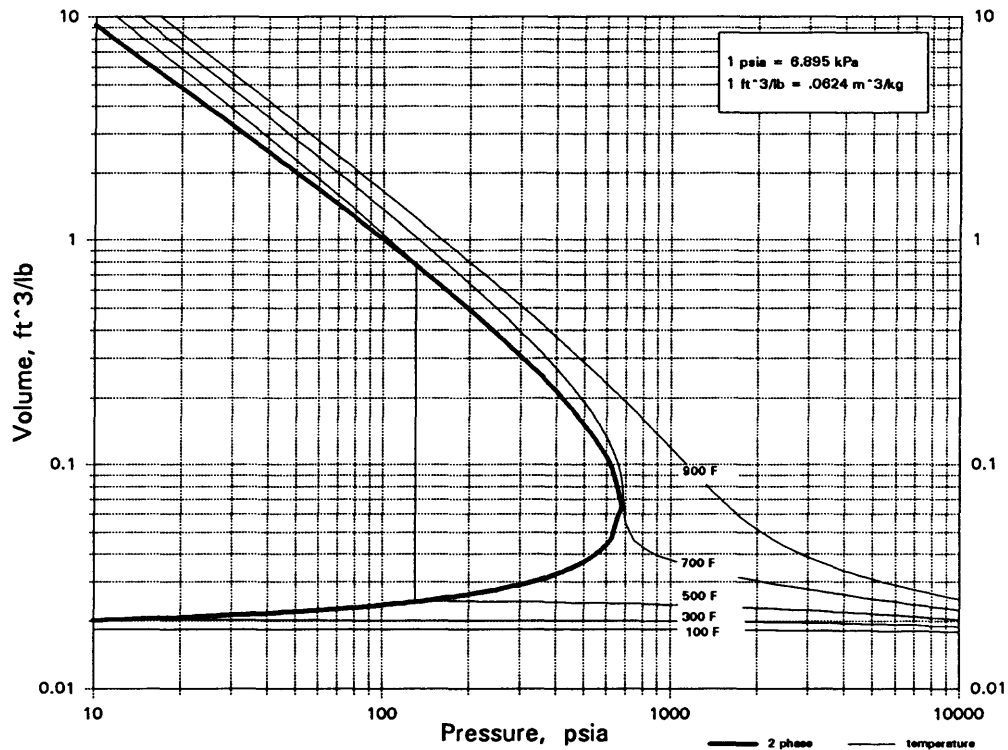


C4H6O2
trans-CROTONIC ACID

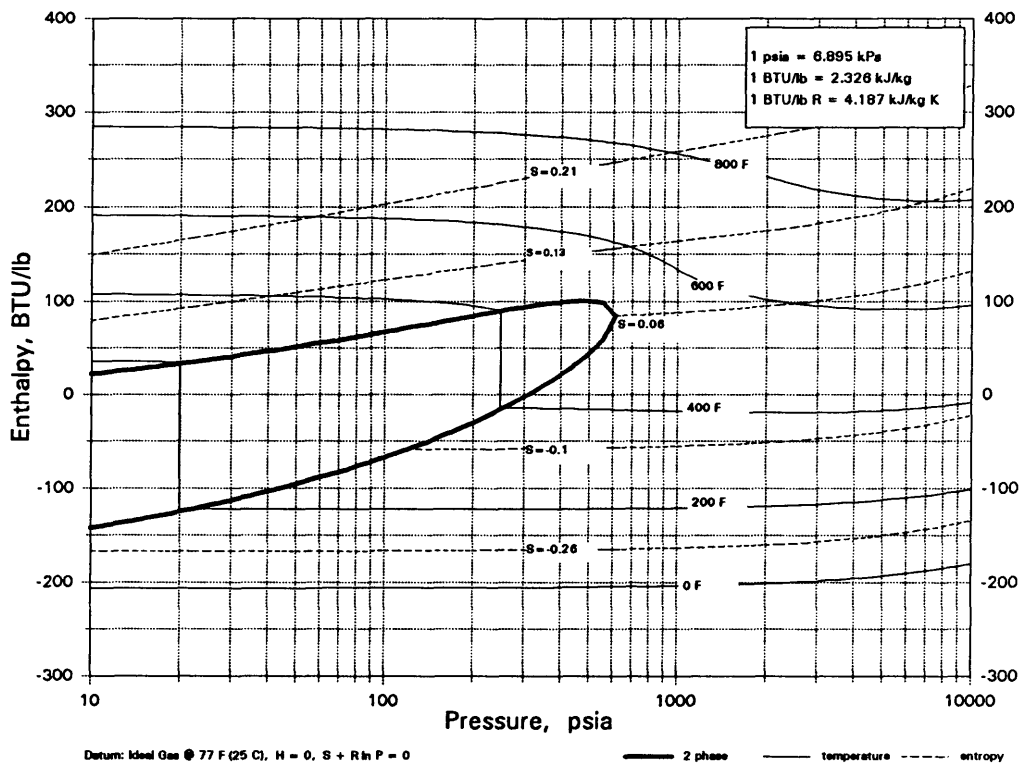
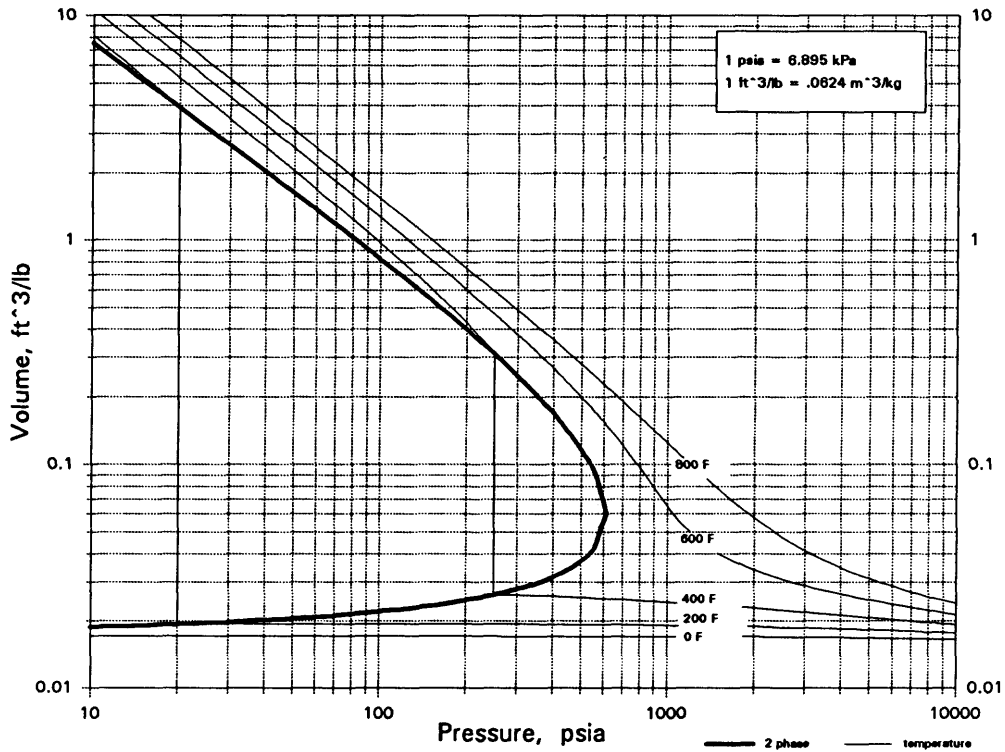


C4H6O2

METHACRYLIC ACID

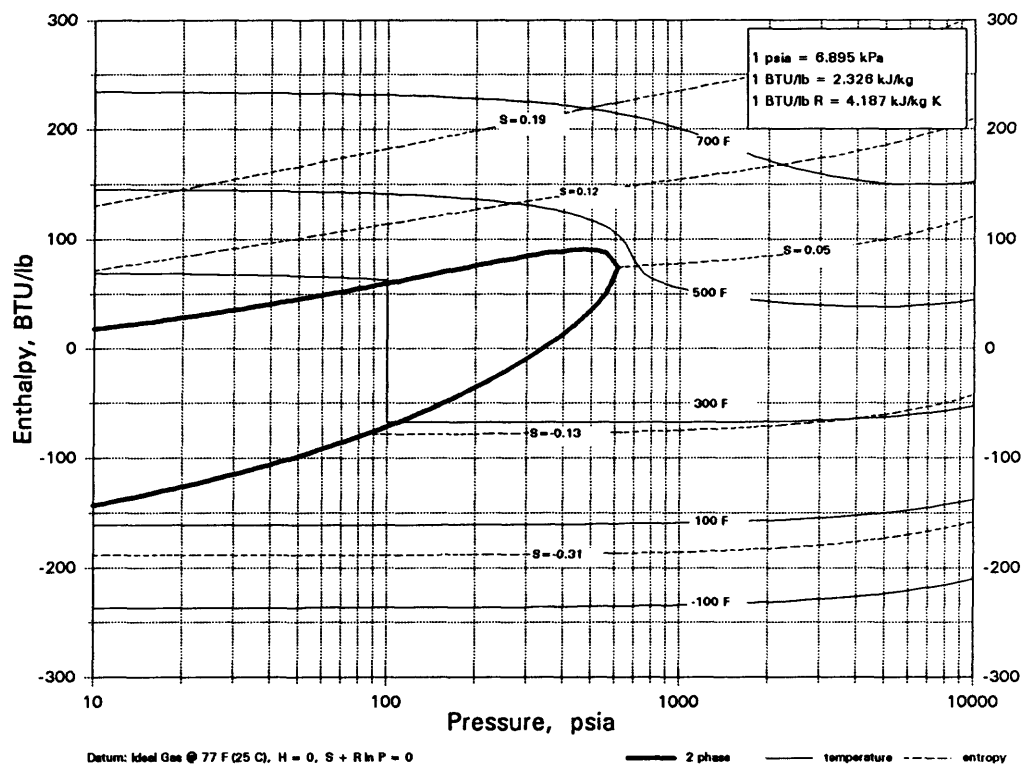
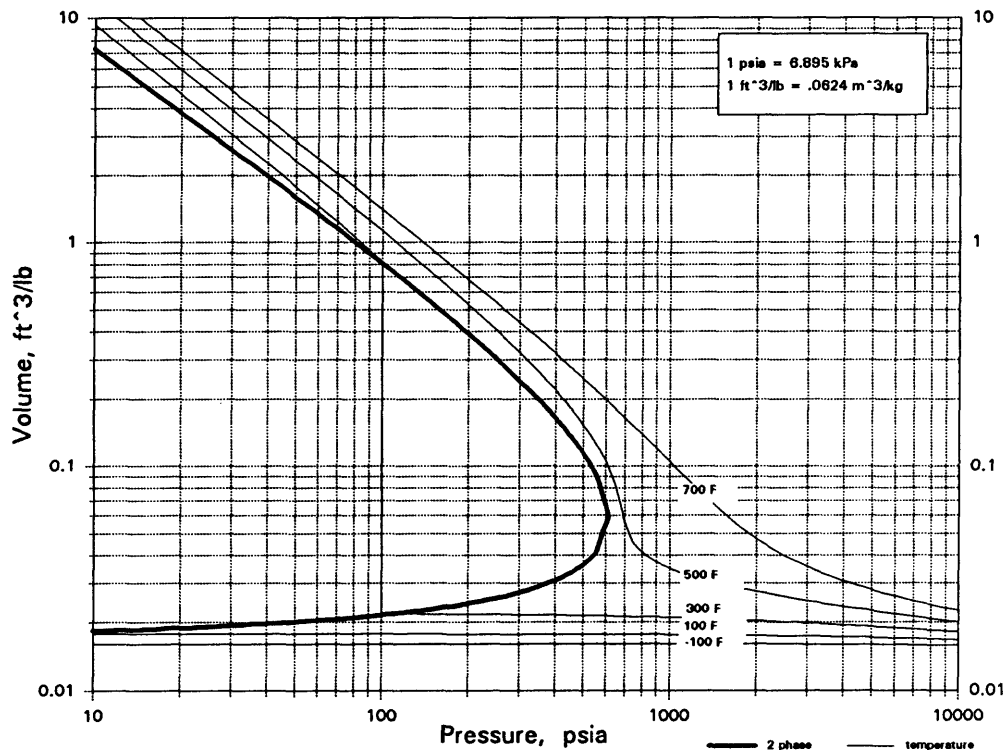


C4H6O2
METHYL ACRYLATE



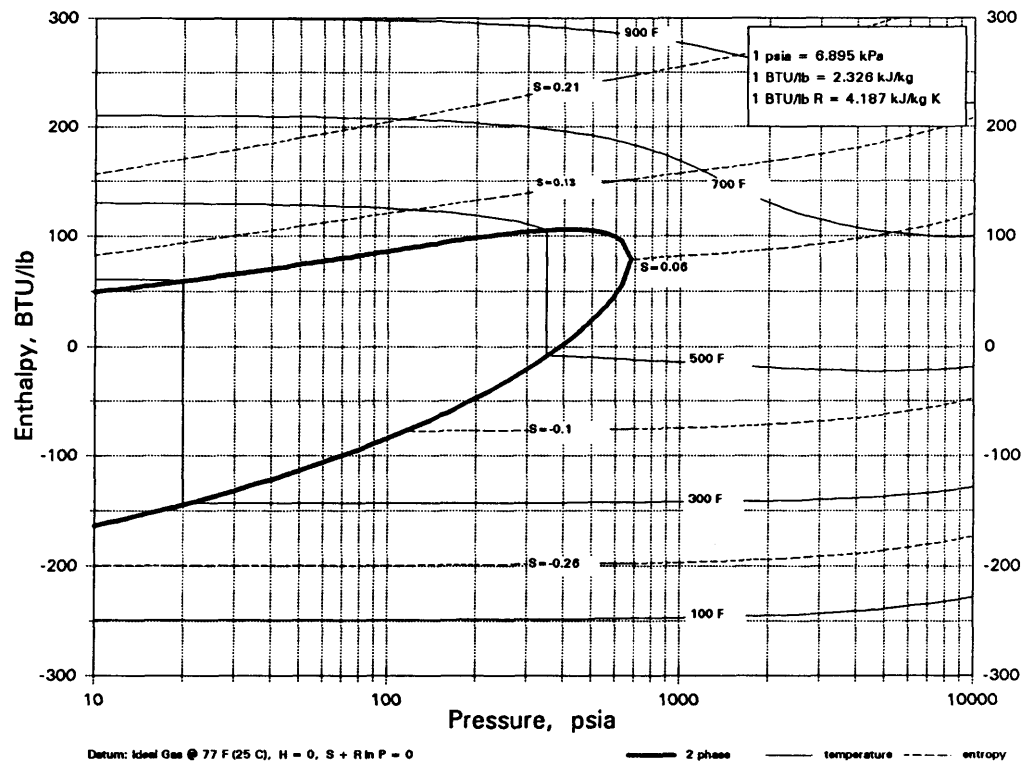
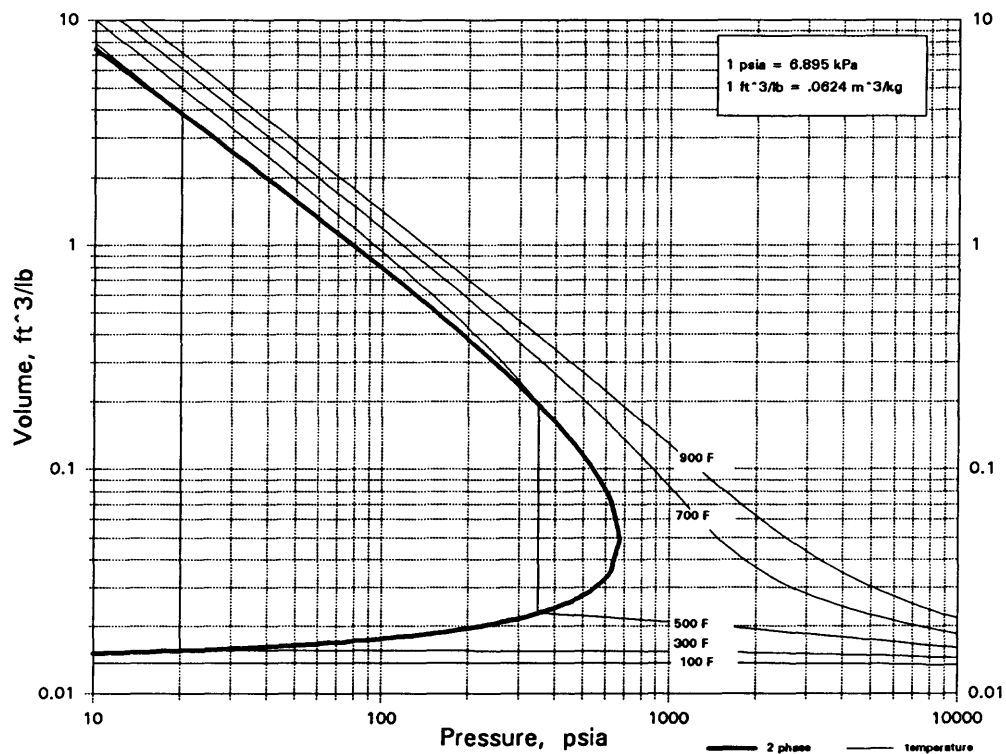
C4H6O2

VINYL ACETATE



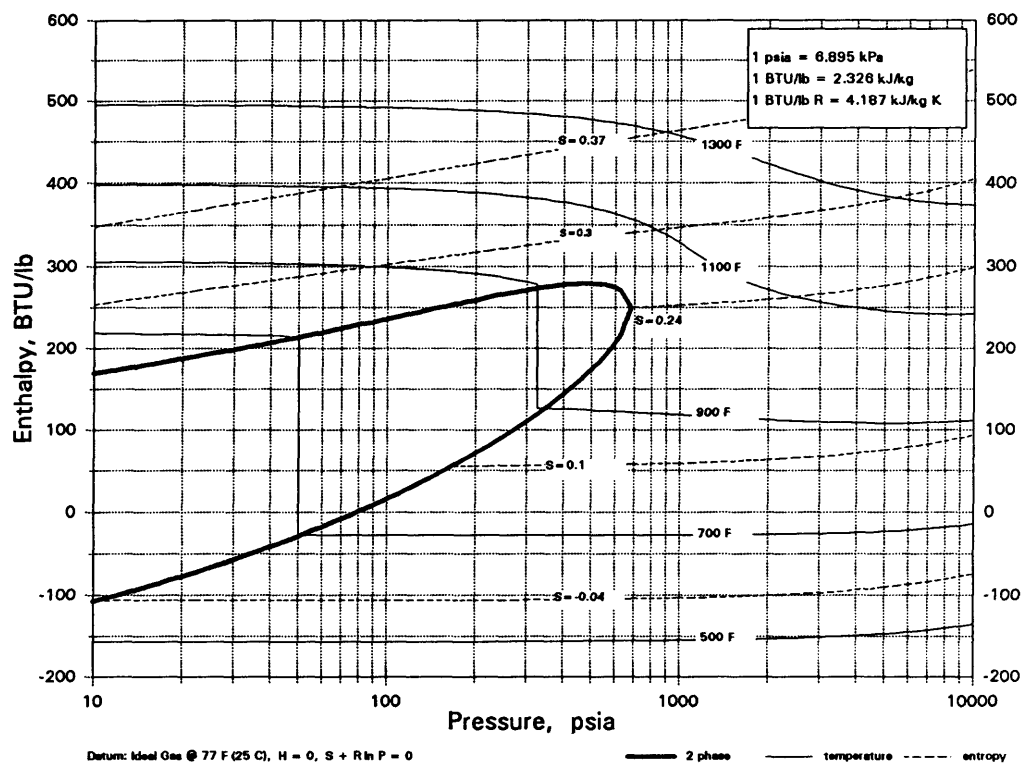
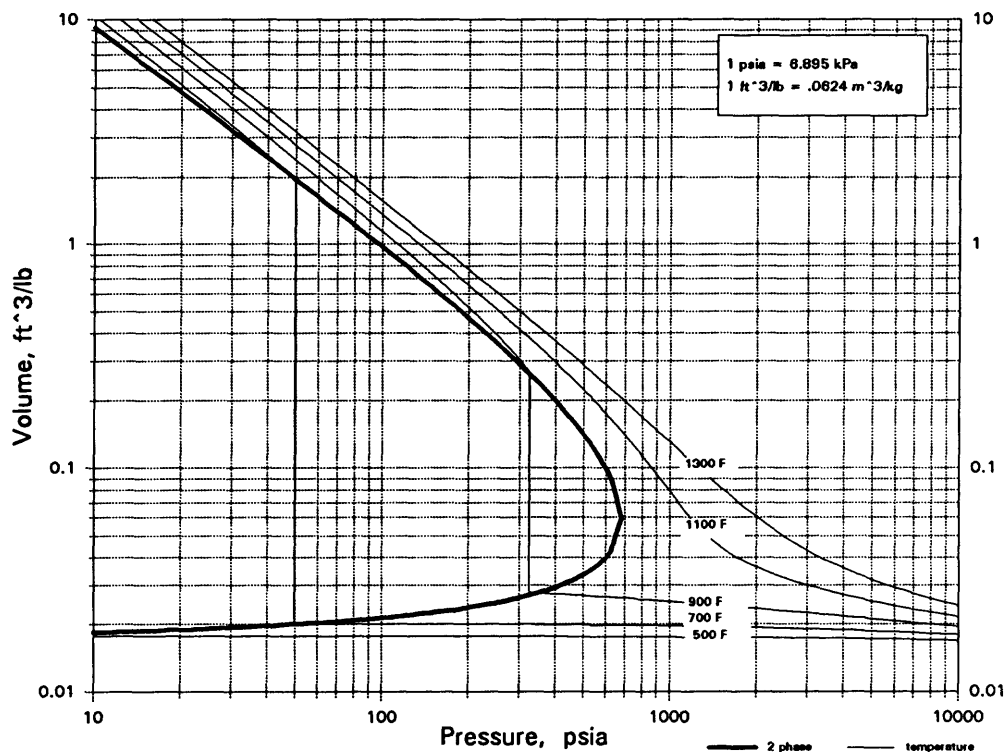
C4H6O3

ACETIC ANHYDRIDE



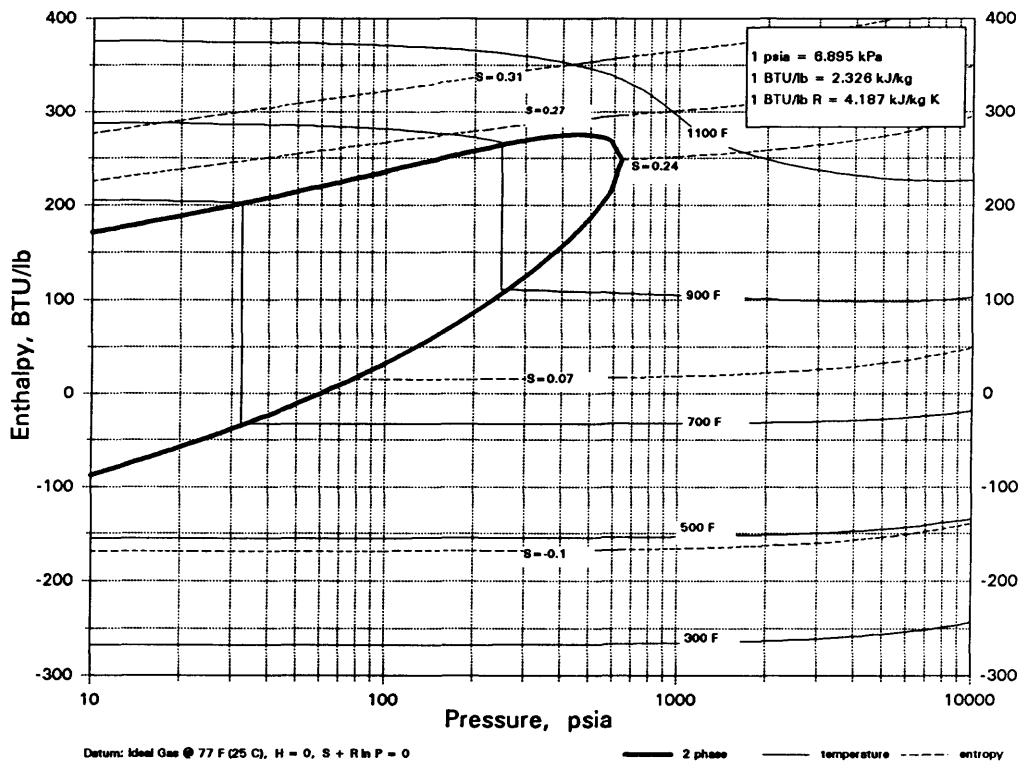
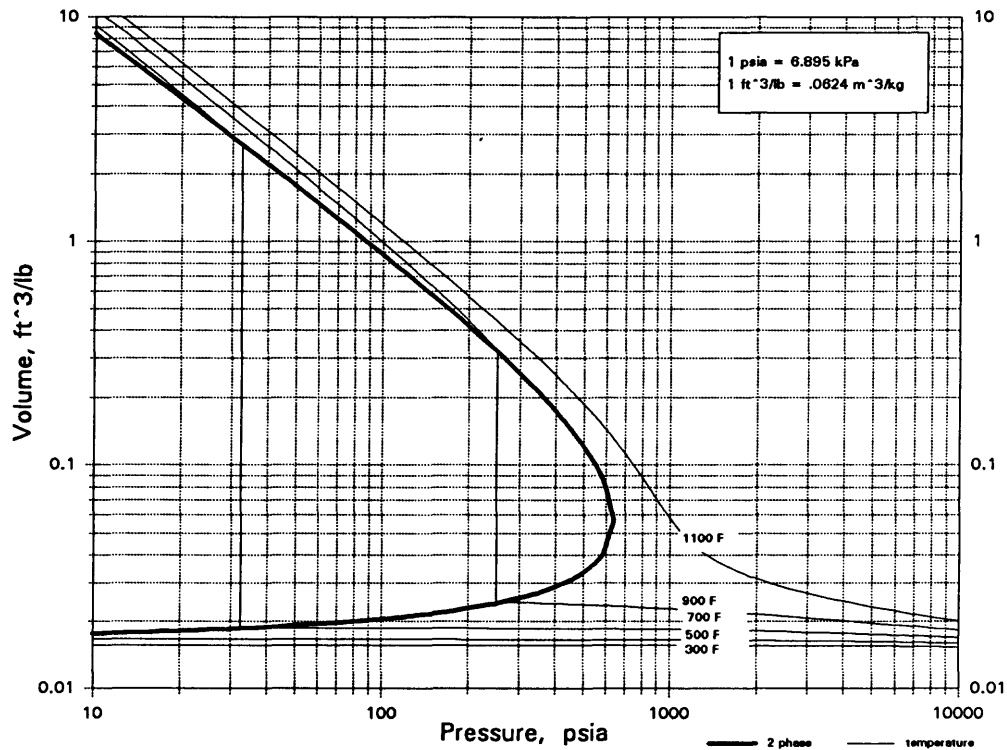
C₄H₆O₄

SUCCINIC ACID



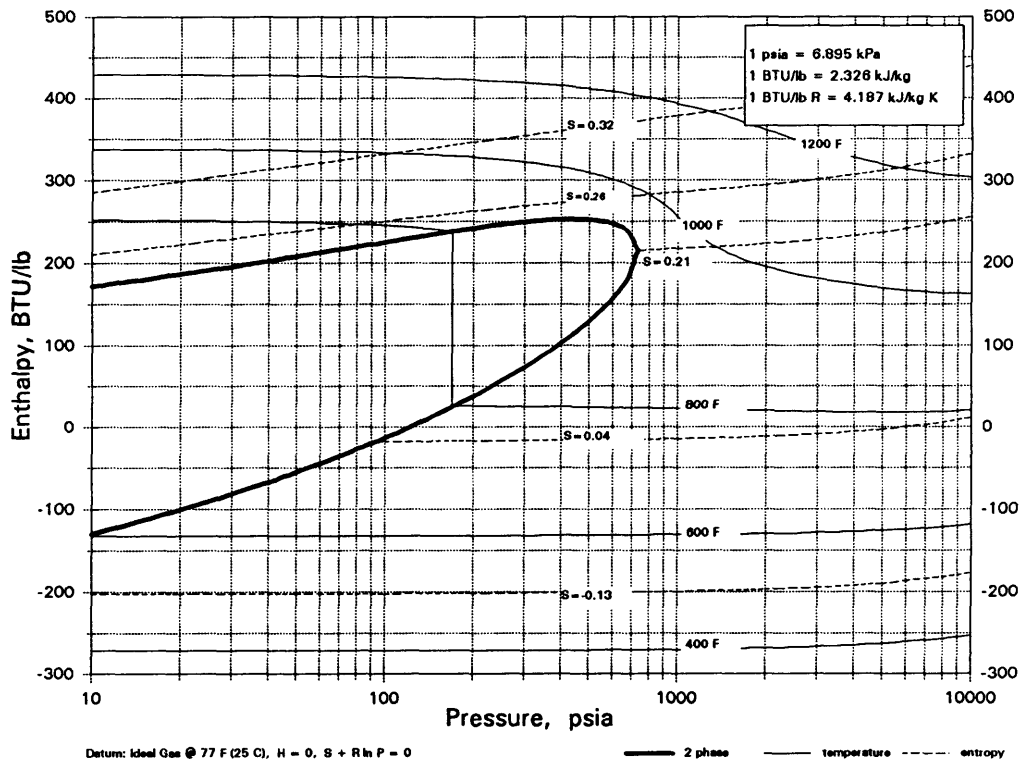
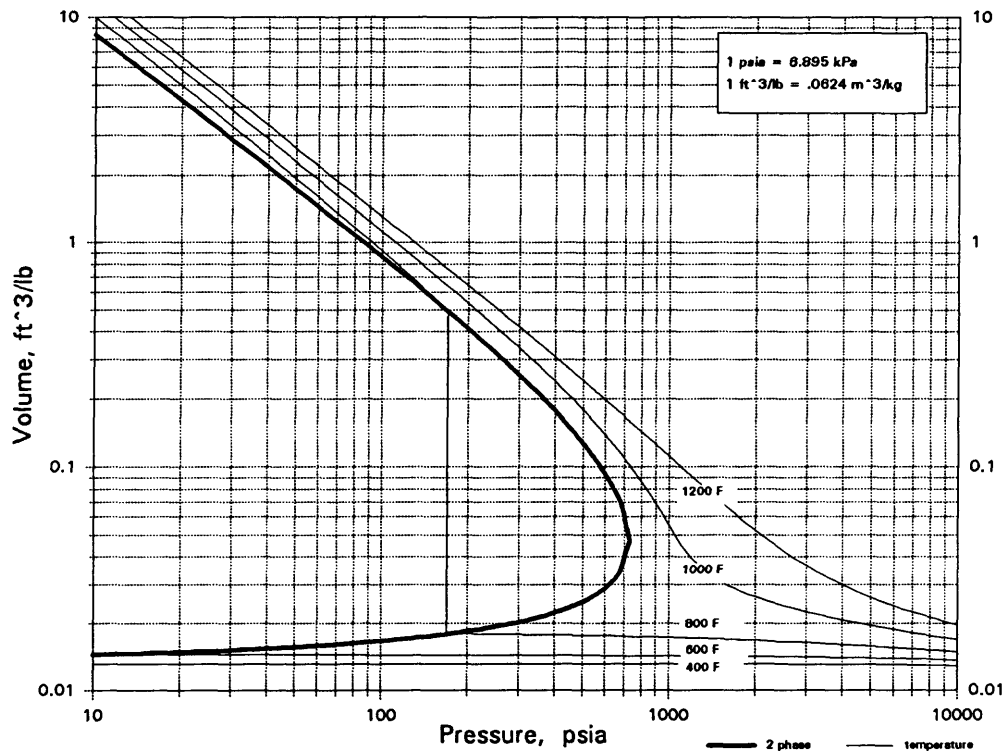
C4H6O5

DIGLYCOLIC ACID

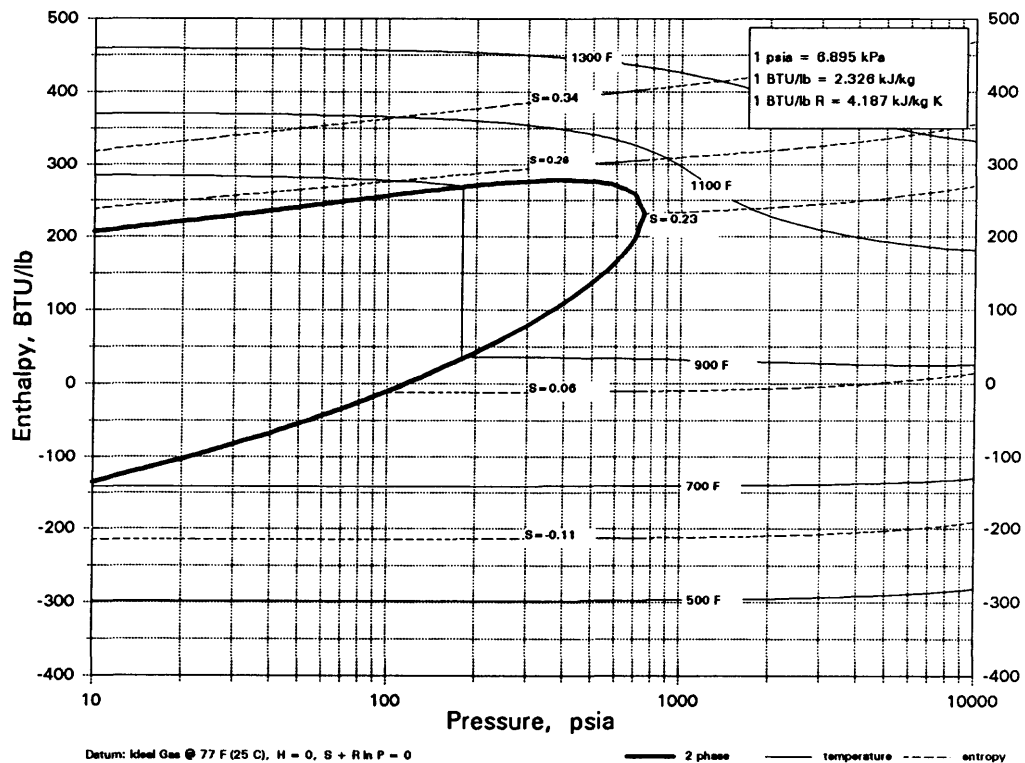
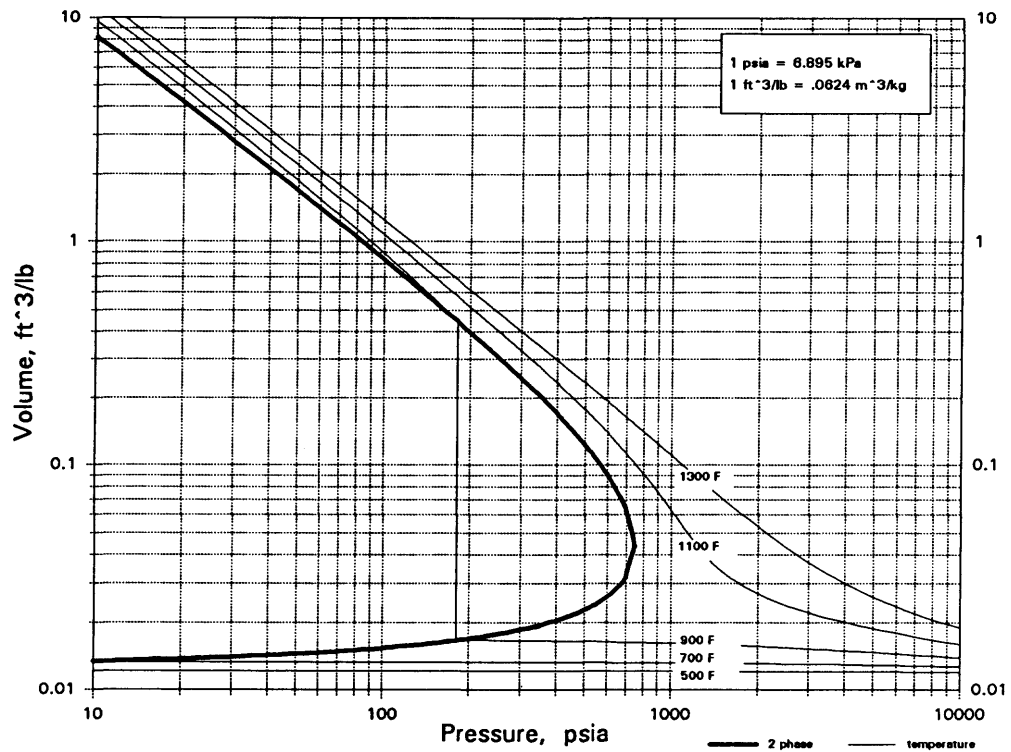


C4H6O5

MALIC ACID

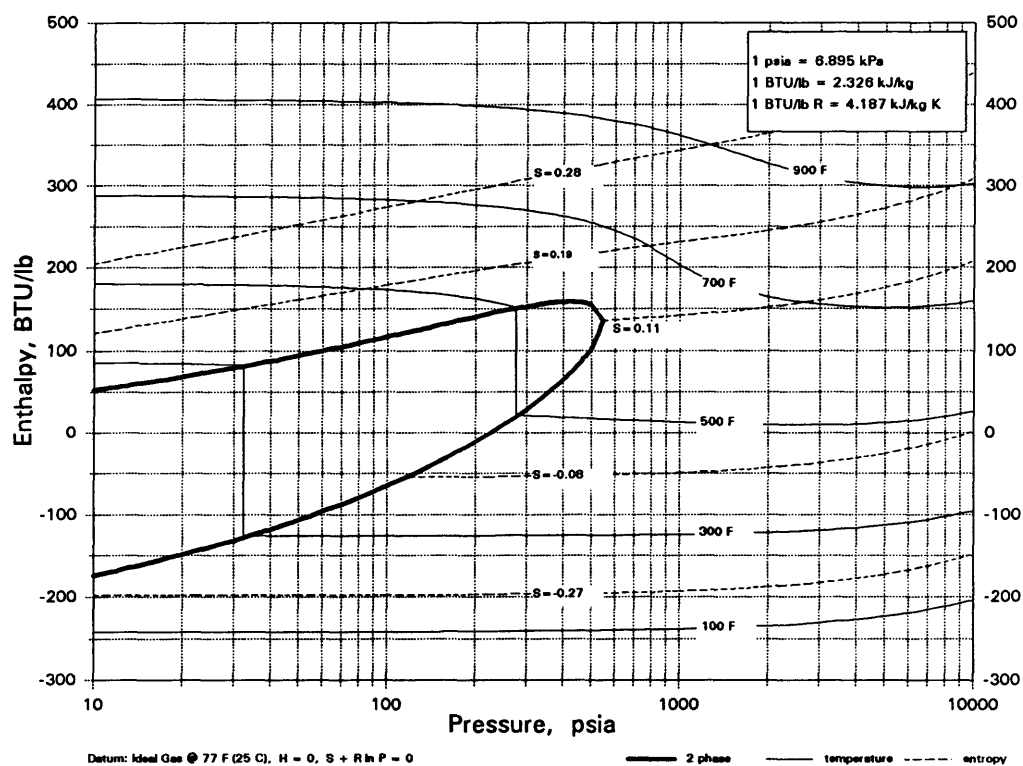
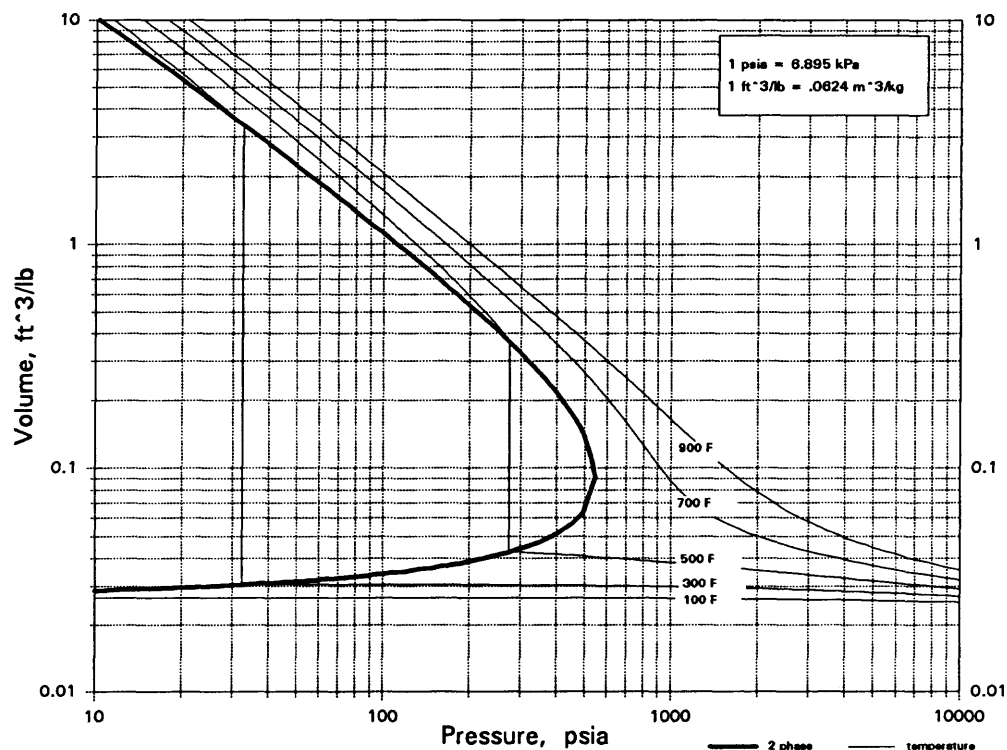


C4H6O6
TARTARIC ACID

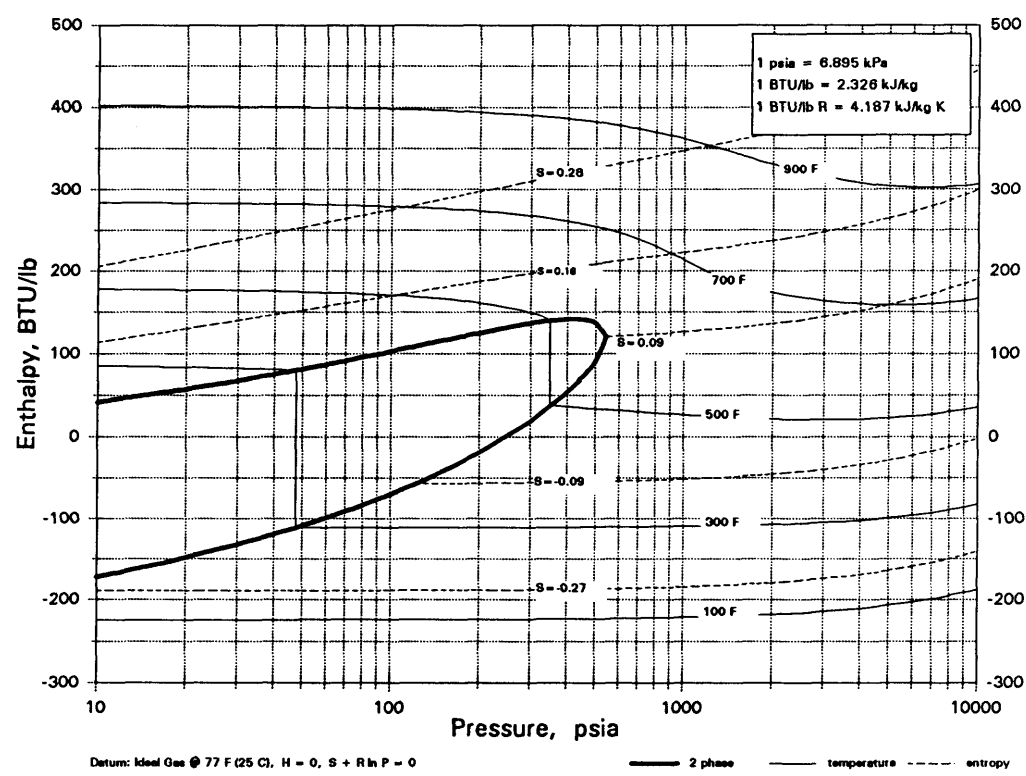
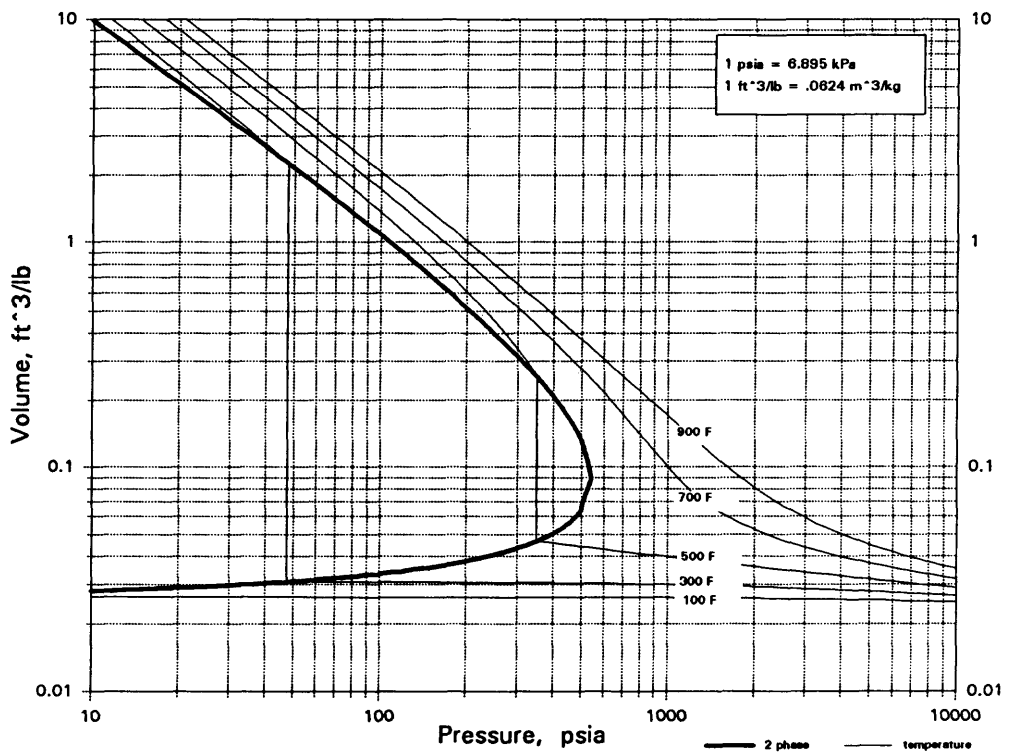


C4H7N

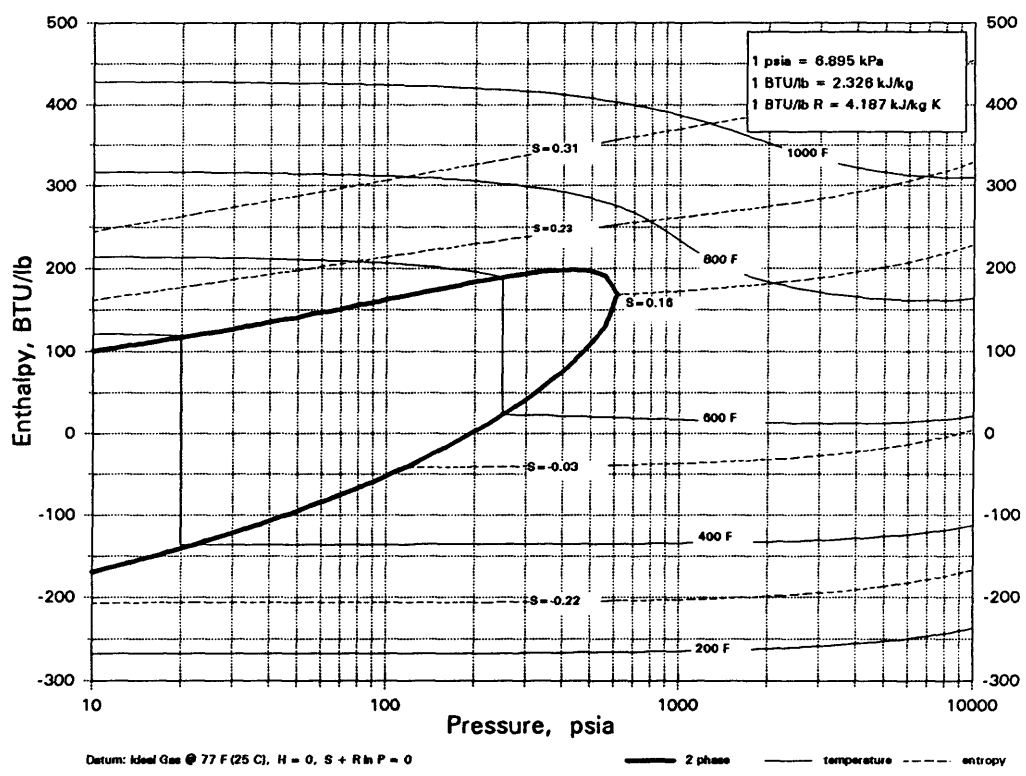
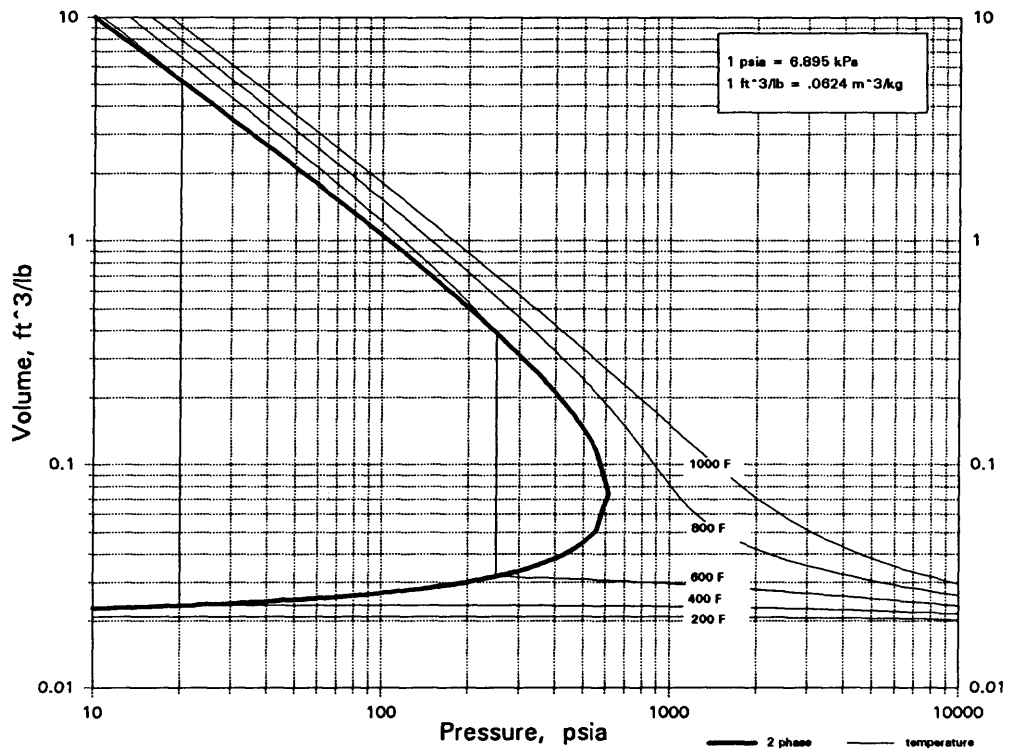
n-BUTYRONITRILE



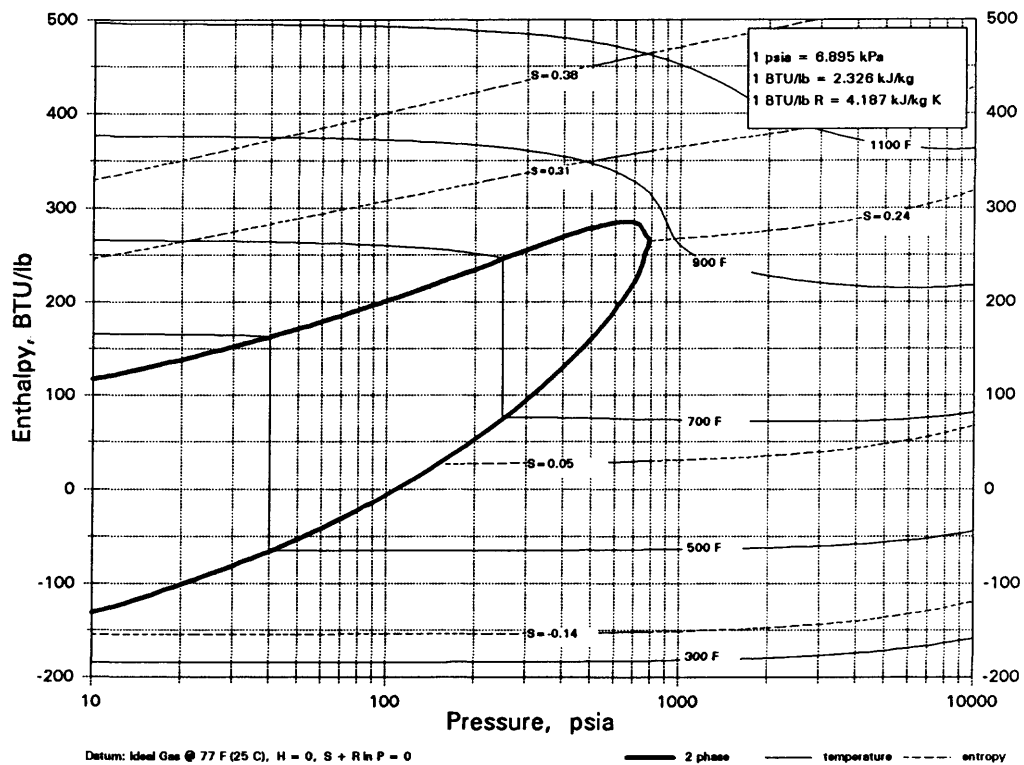
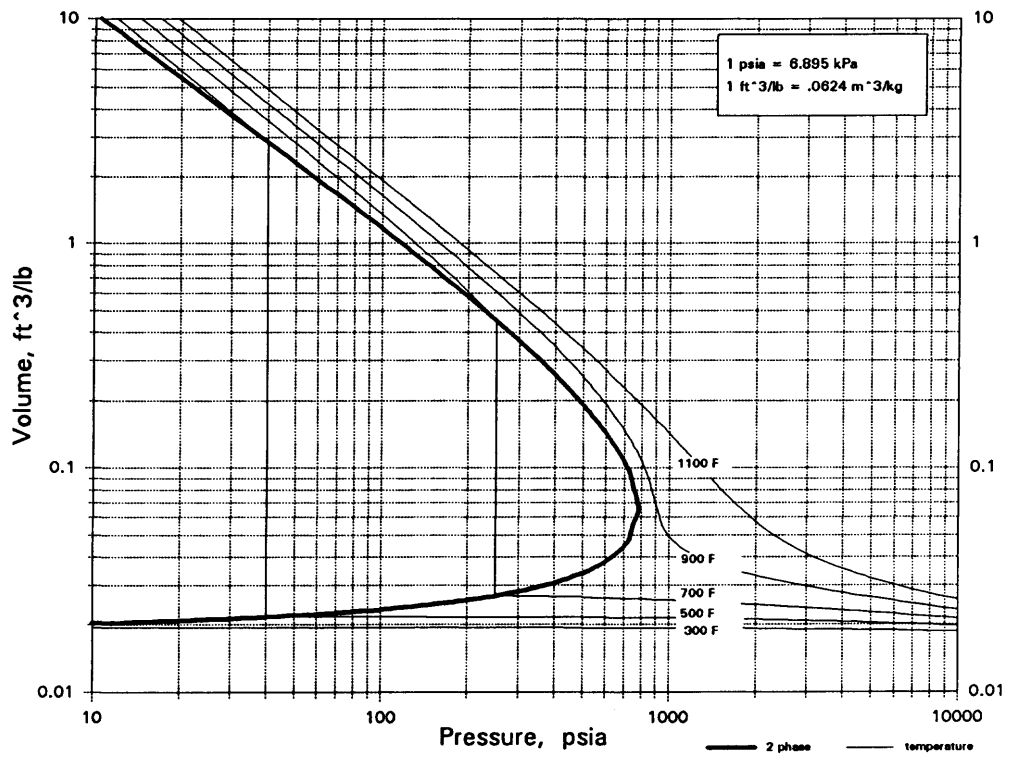
C4H7N
ISOBUTYRONITRILE



C₄H₇NO
ACETONE CYANOHYDRIN

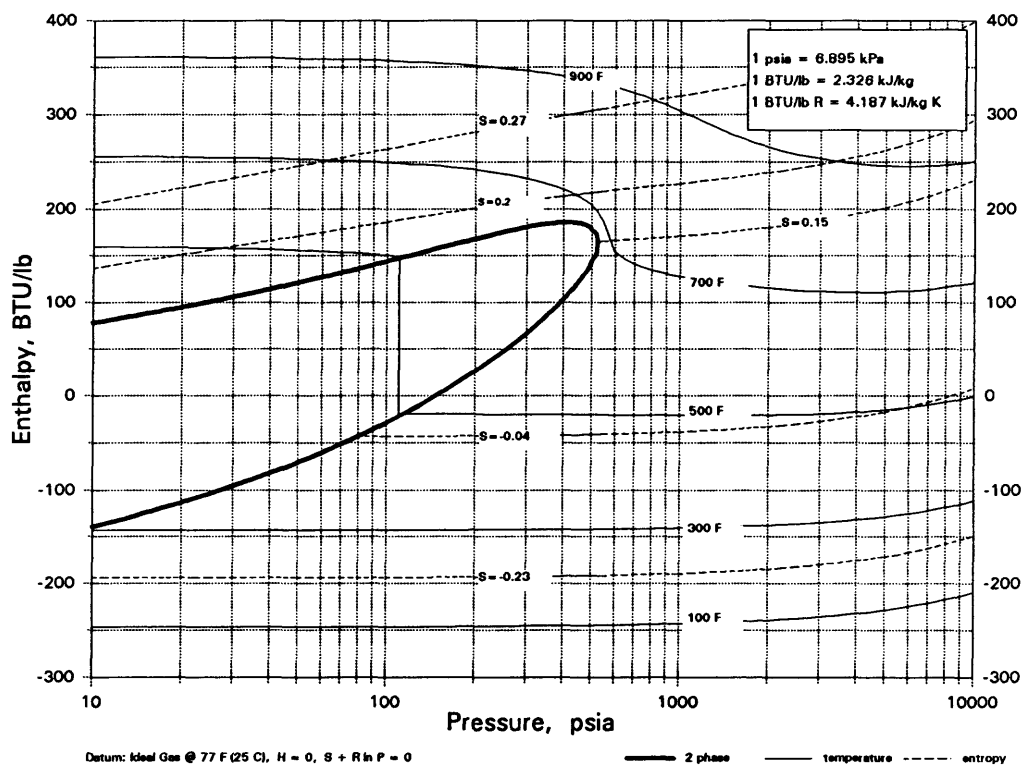
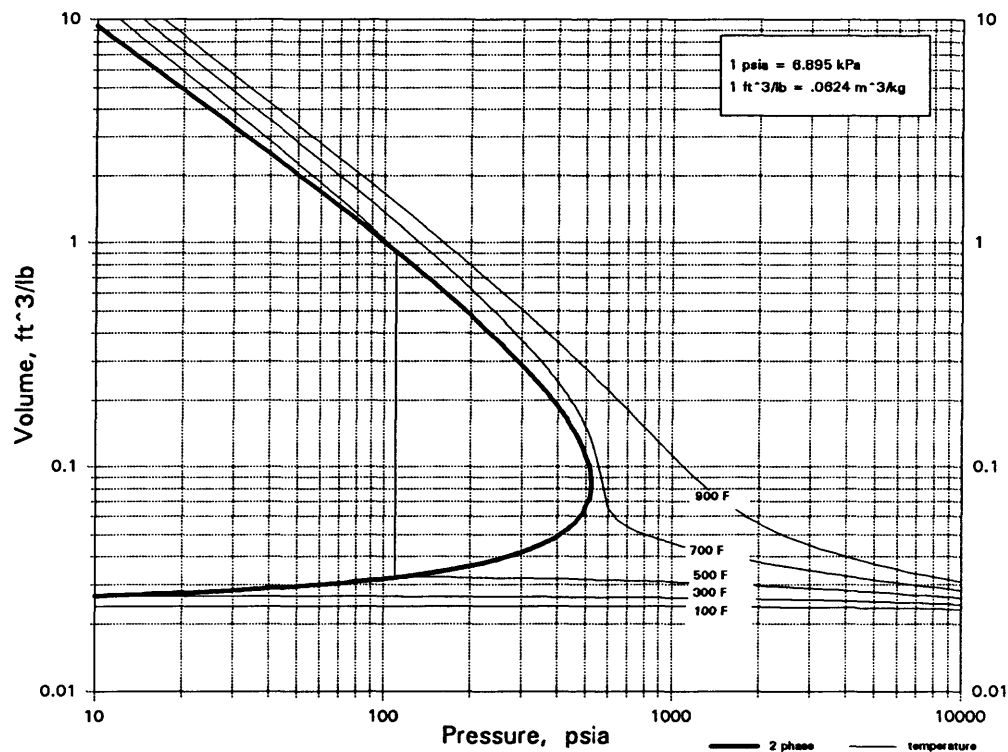


C₄H₇NO
2-METHACRYLAMIDE



C4H7NO

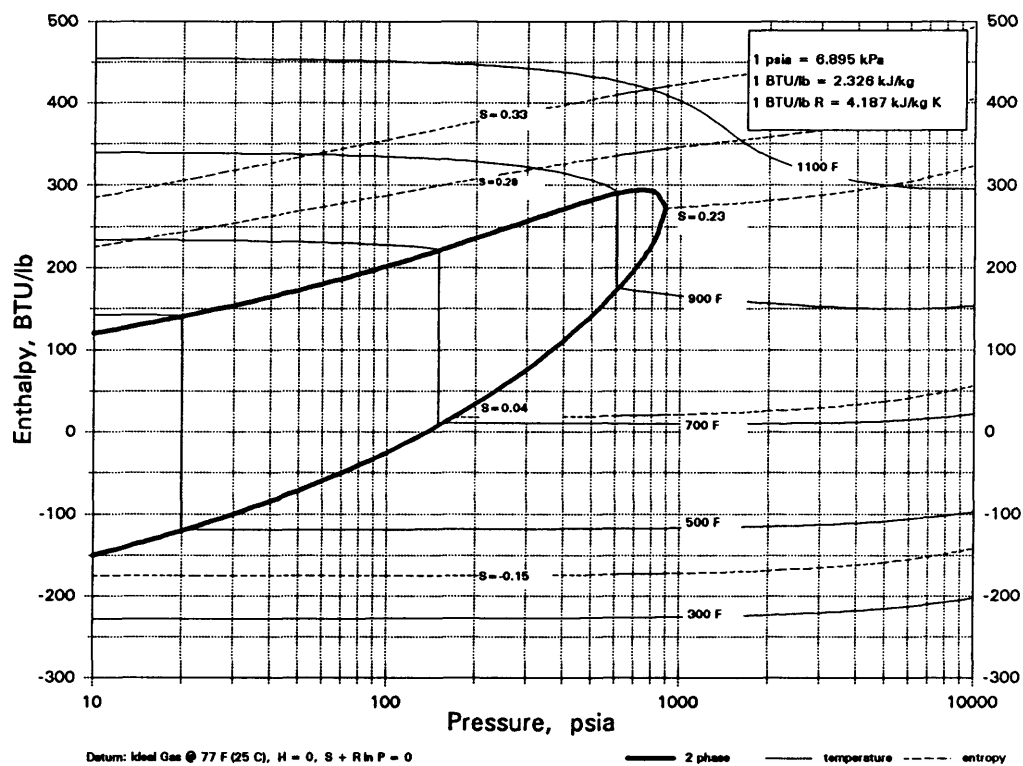
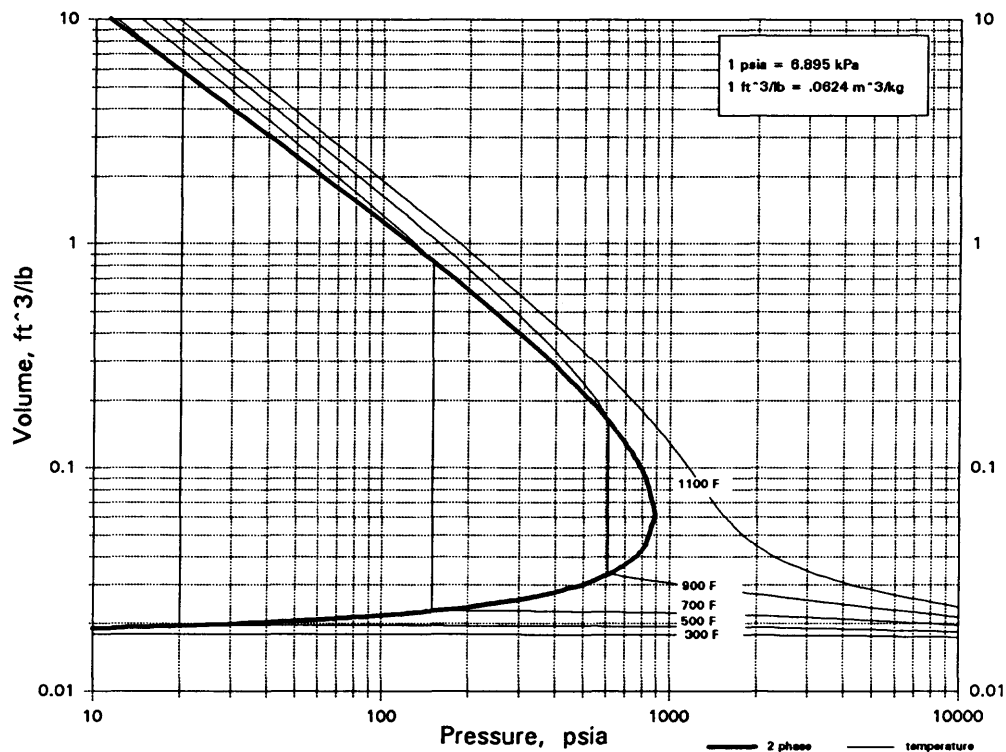
3-METHOXYPROPIONITRILE



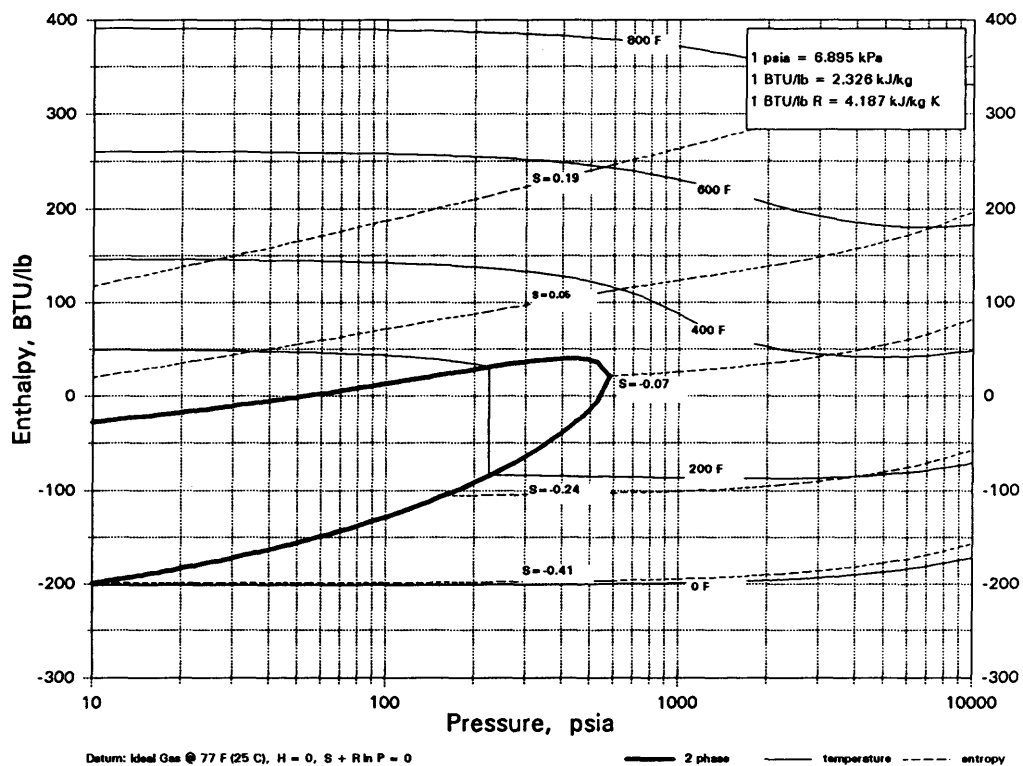
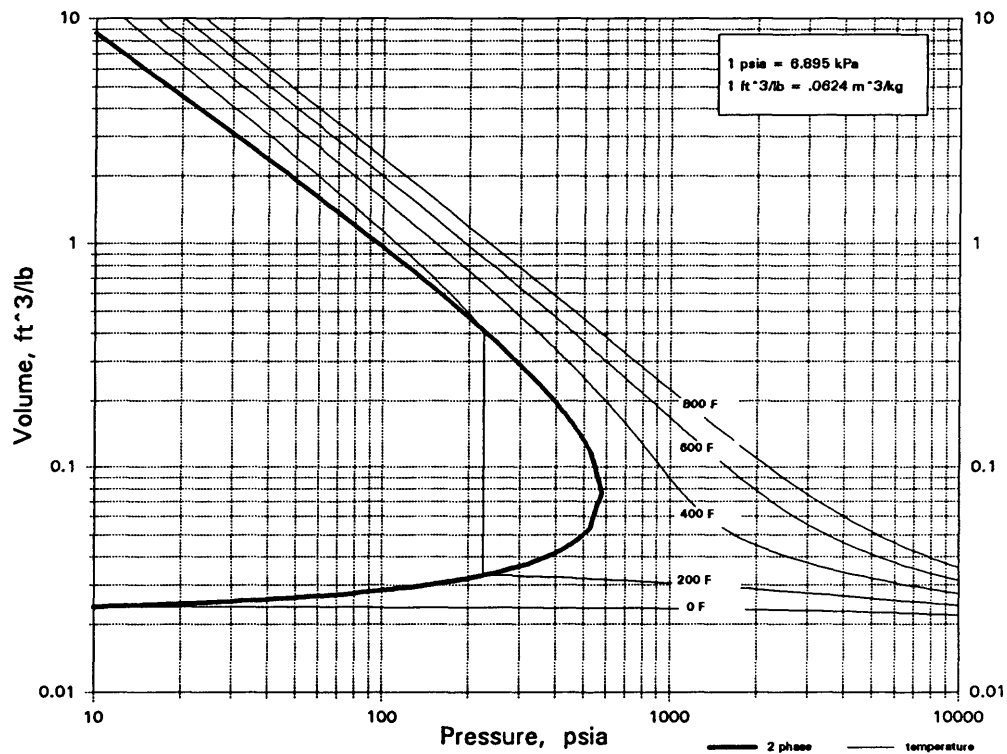
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

C4H7NO

2-PYRROLIDONE

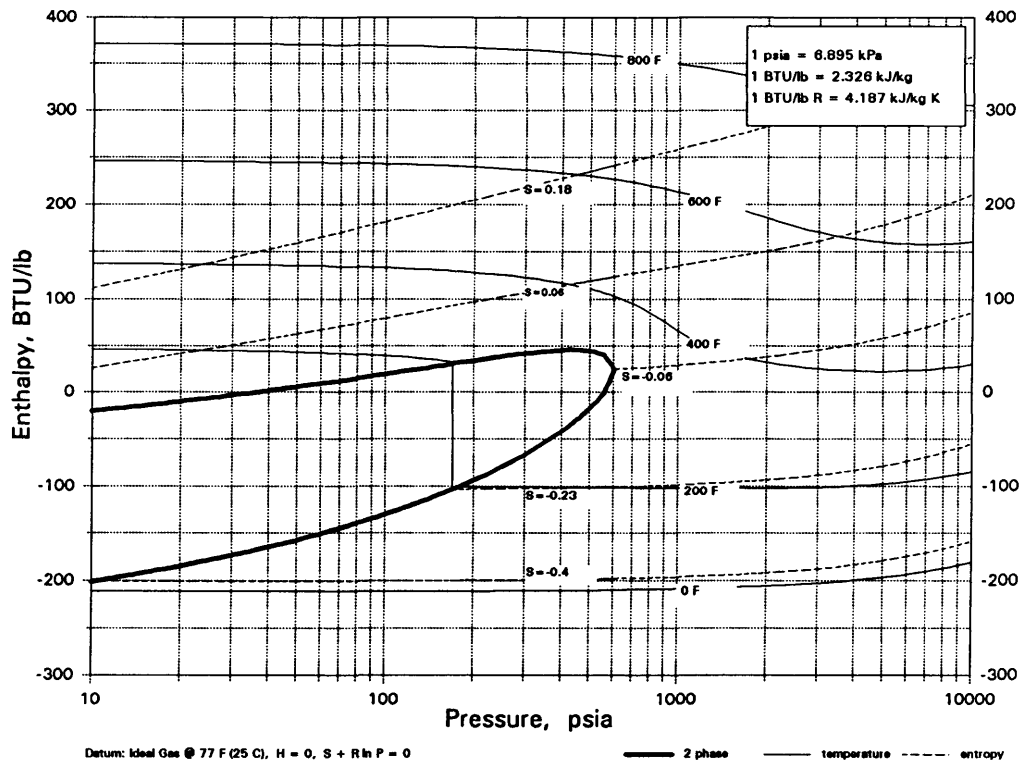
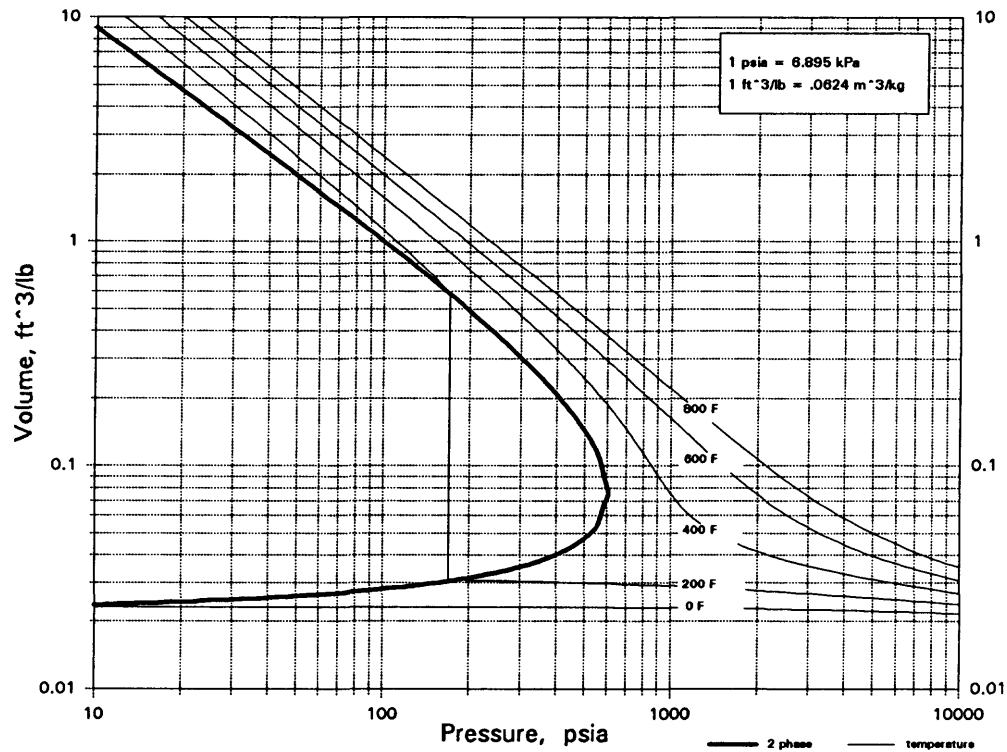


C4H8
1-BUTENE



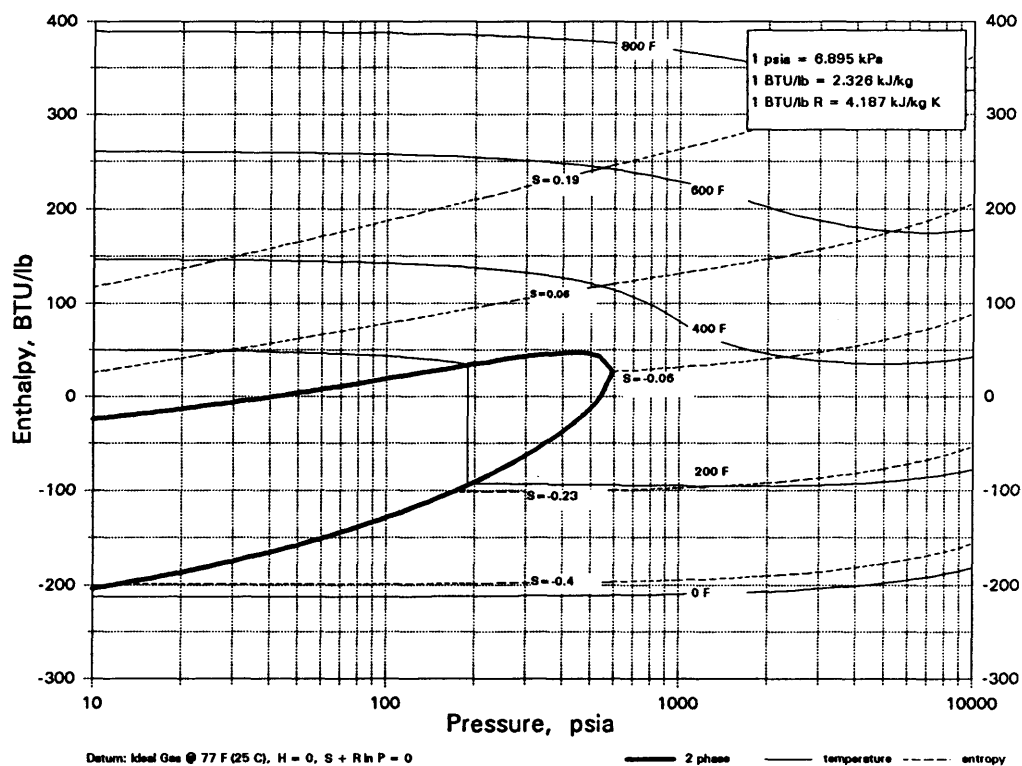
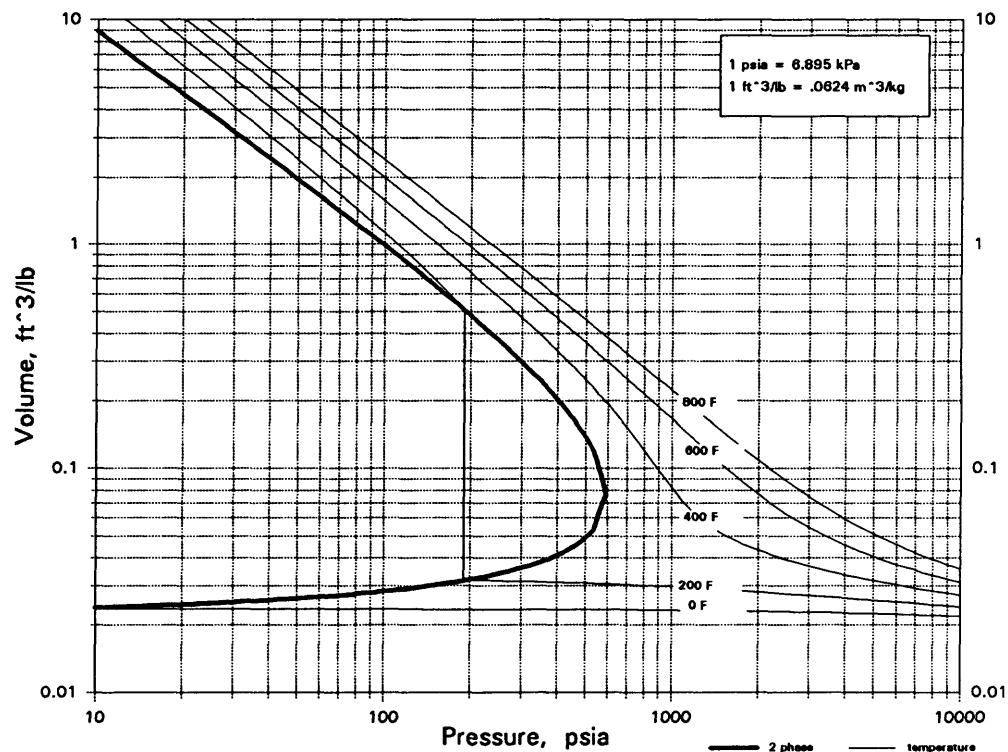
C4H8

cis-2-BUTENE

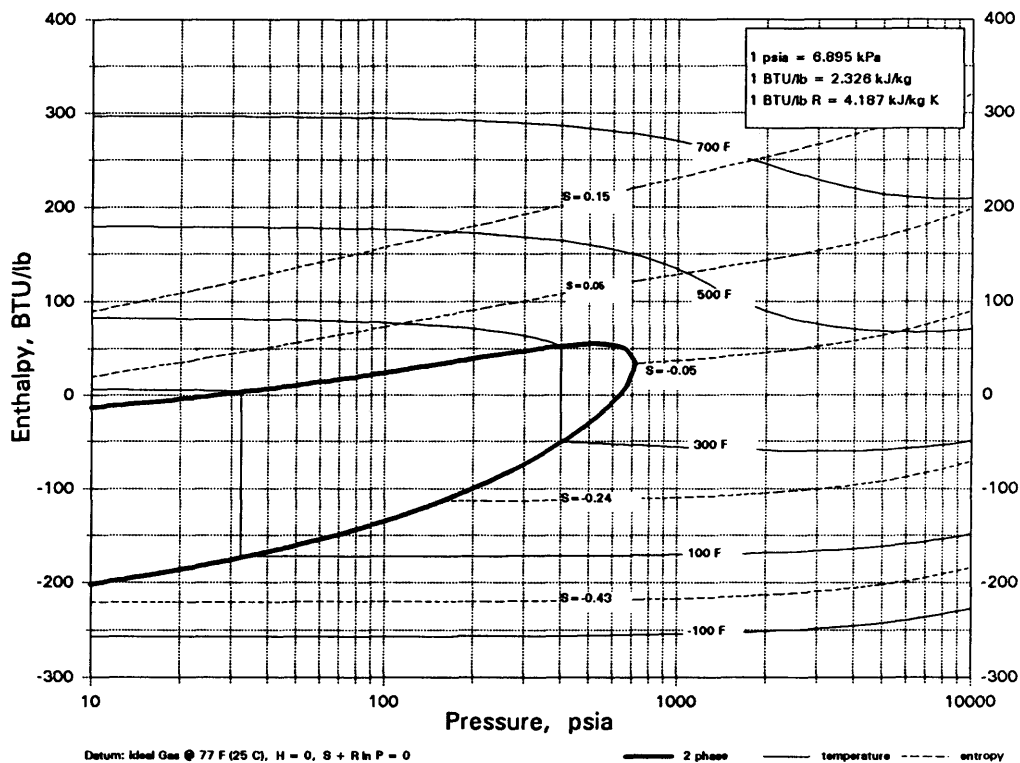
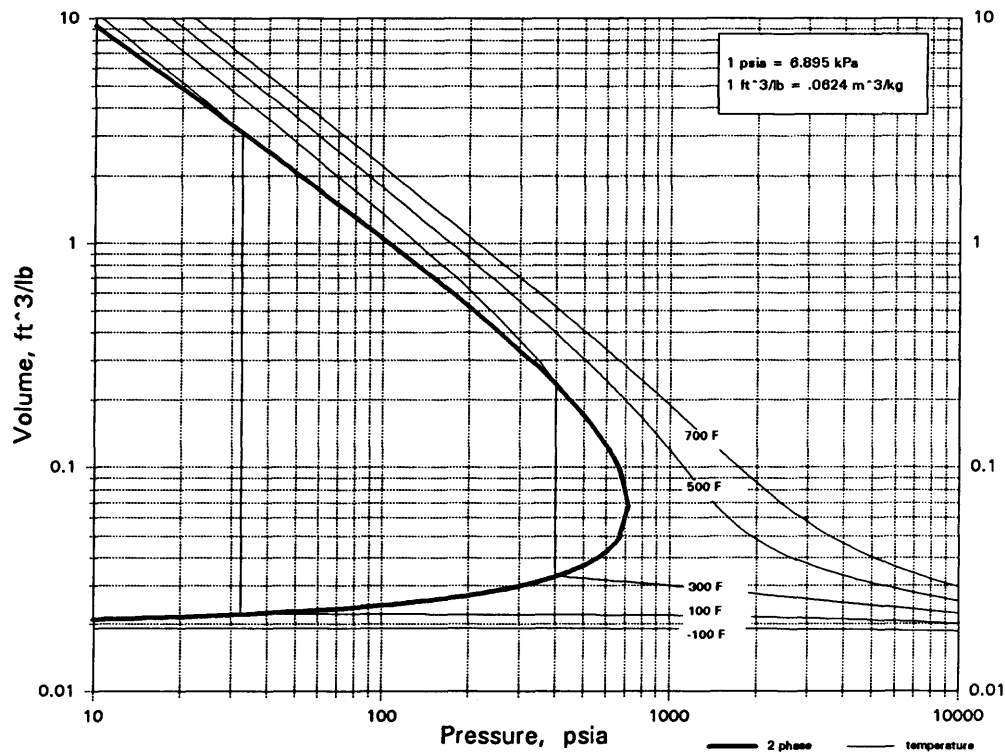


C4H8

trans-2-BUTENE

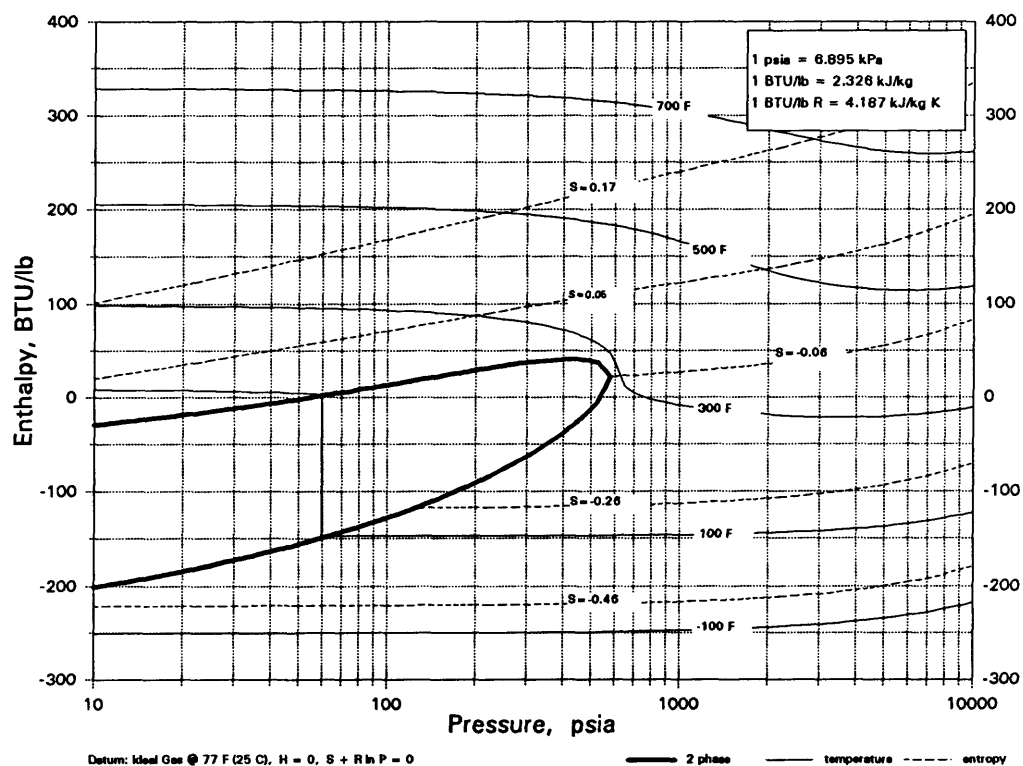
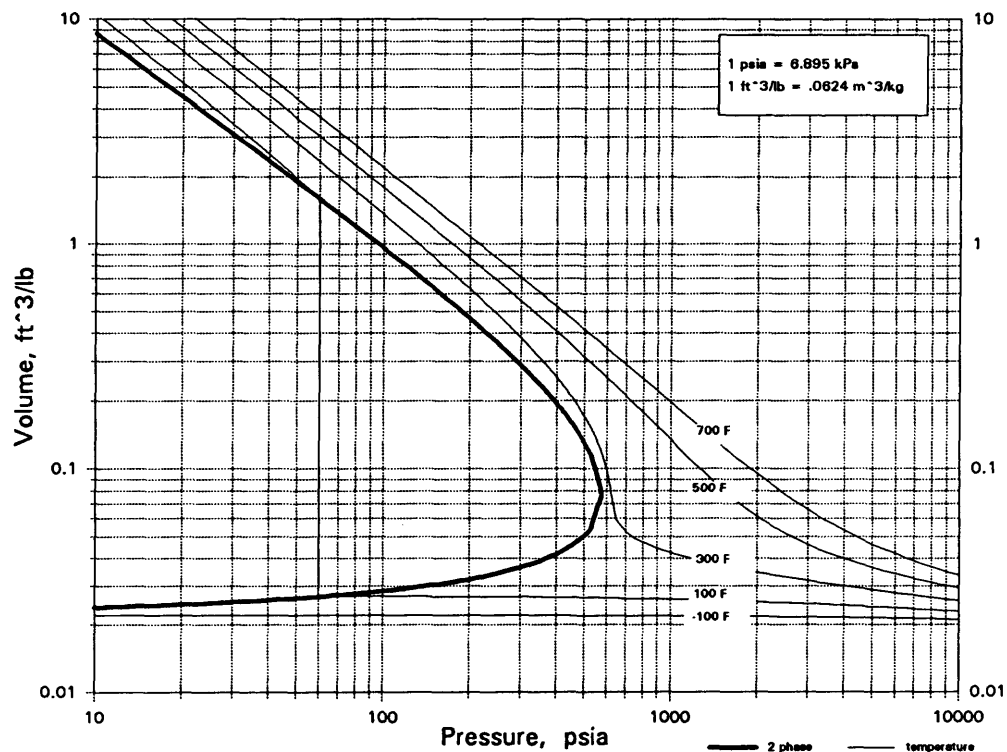


C4H8
CYCLOBUTANE

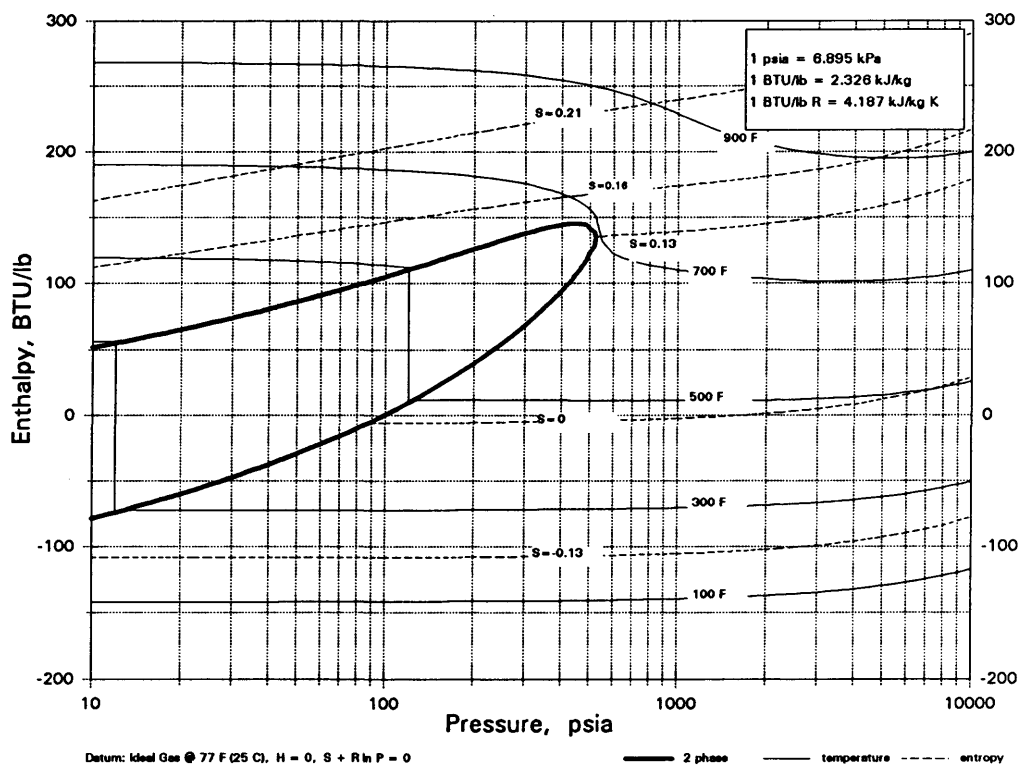
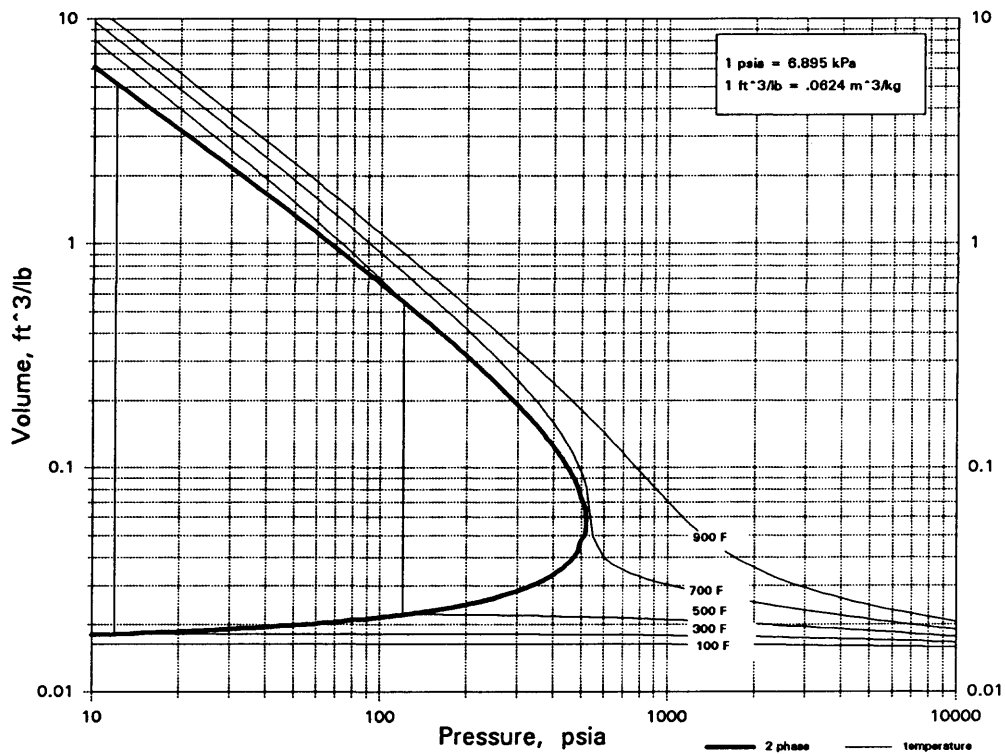


C4H8

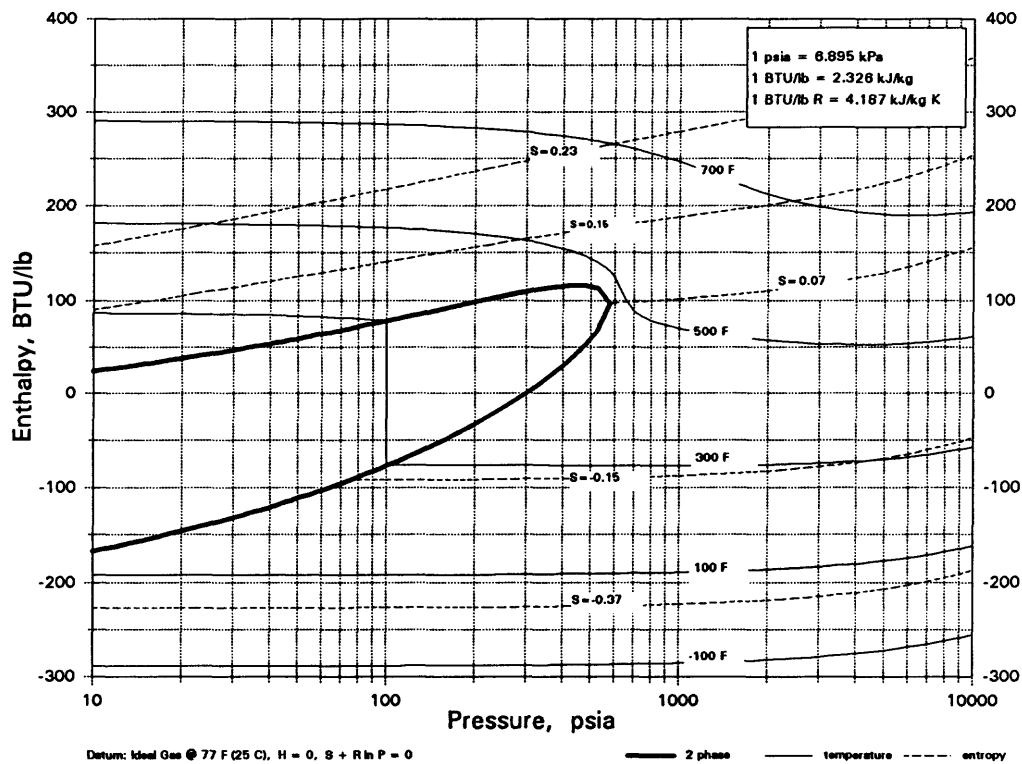
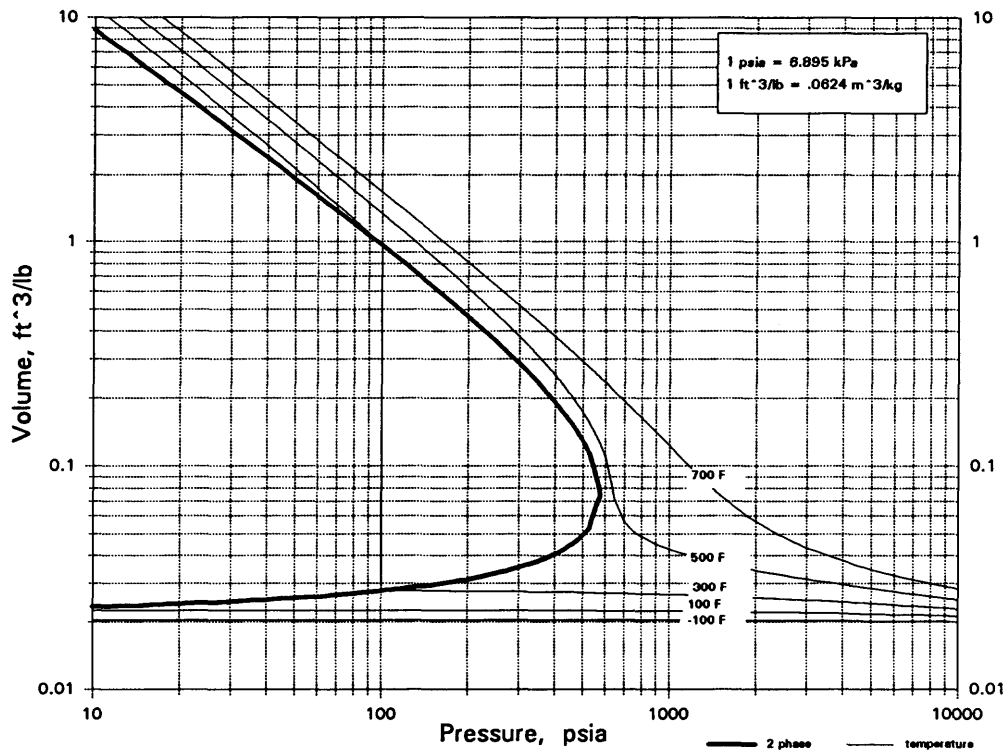
ISOBUTENE



C₄H₈Cl₂
1-4-DICHLOROBUTANE

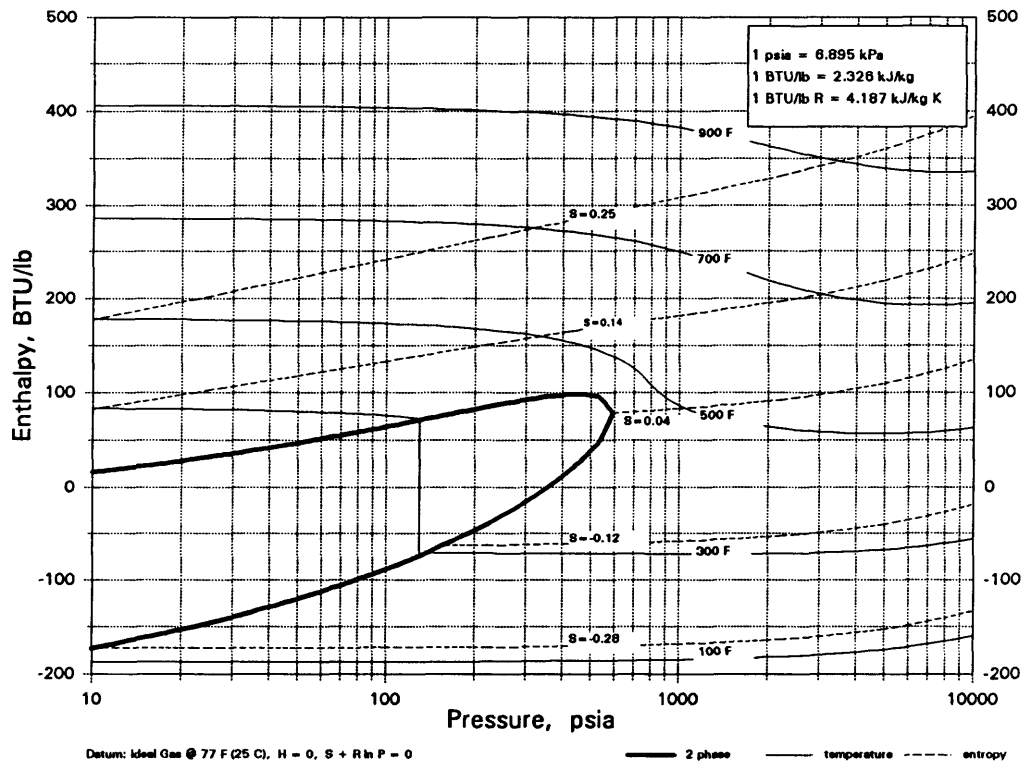
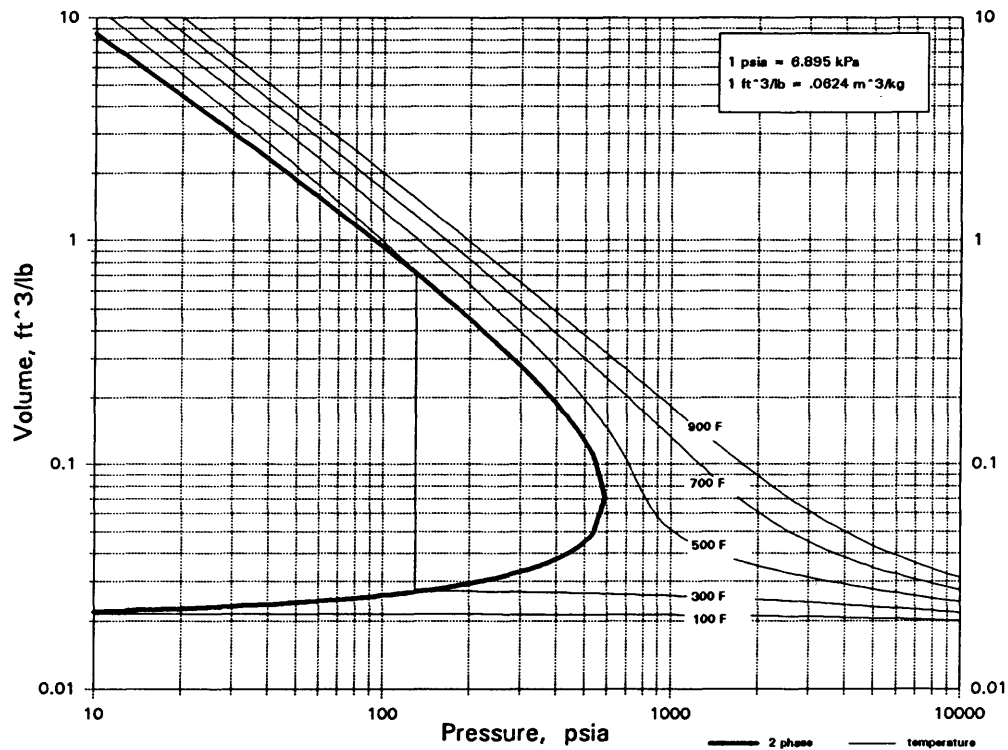


C4H8O
n-BUTYRALDEHYDE



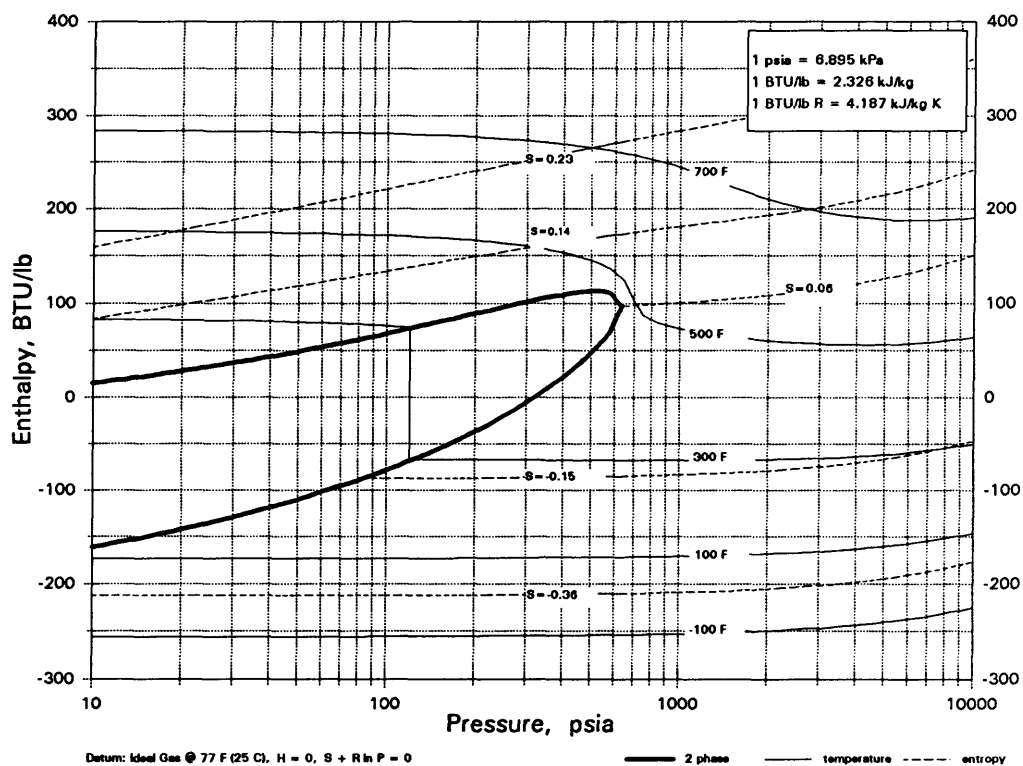
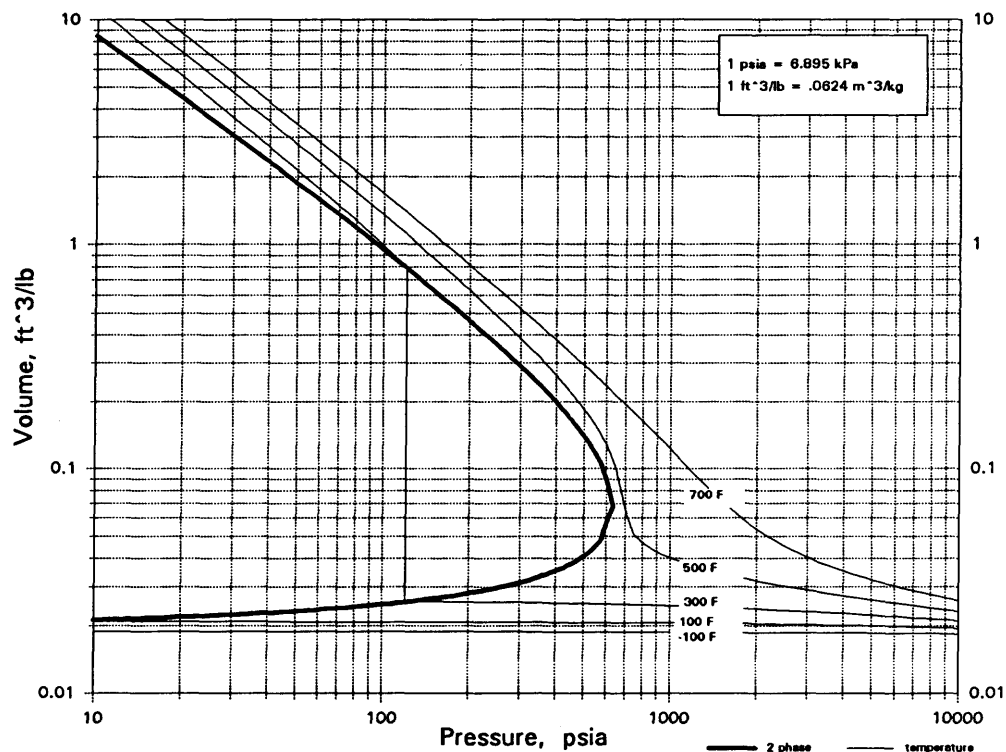
C4H8O

ISOBUTYRALDEHYDE

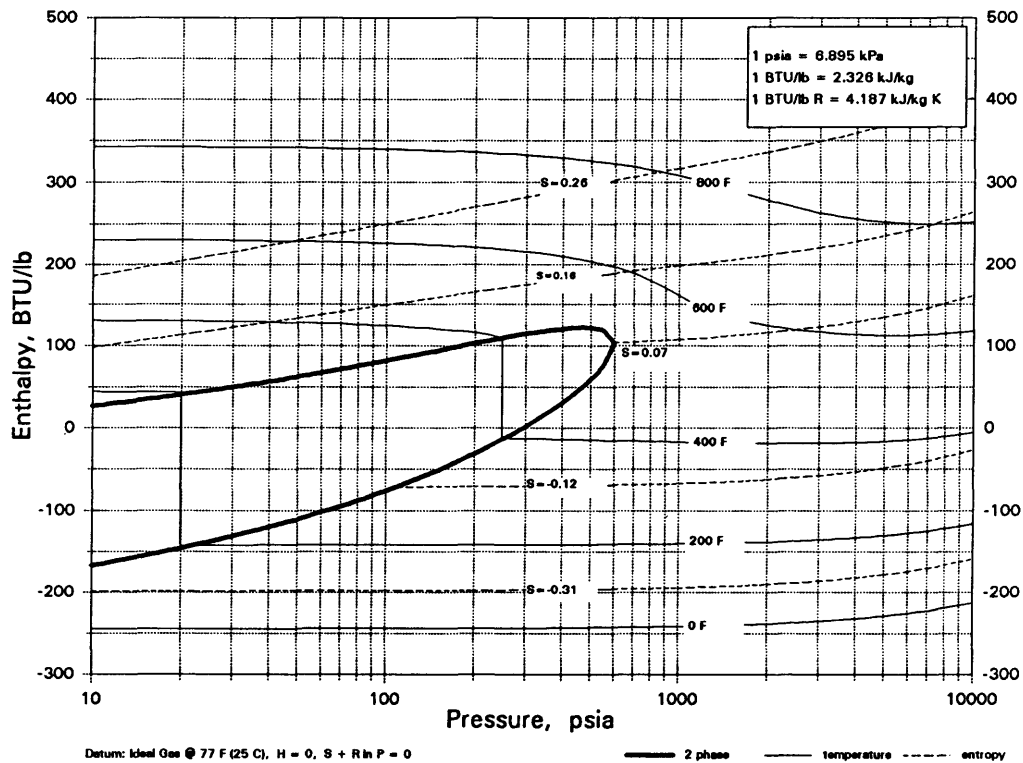
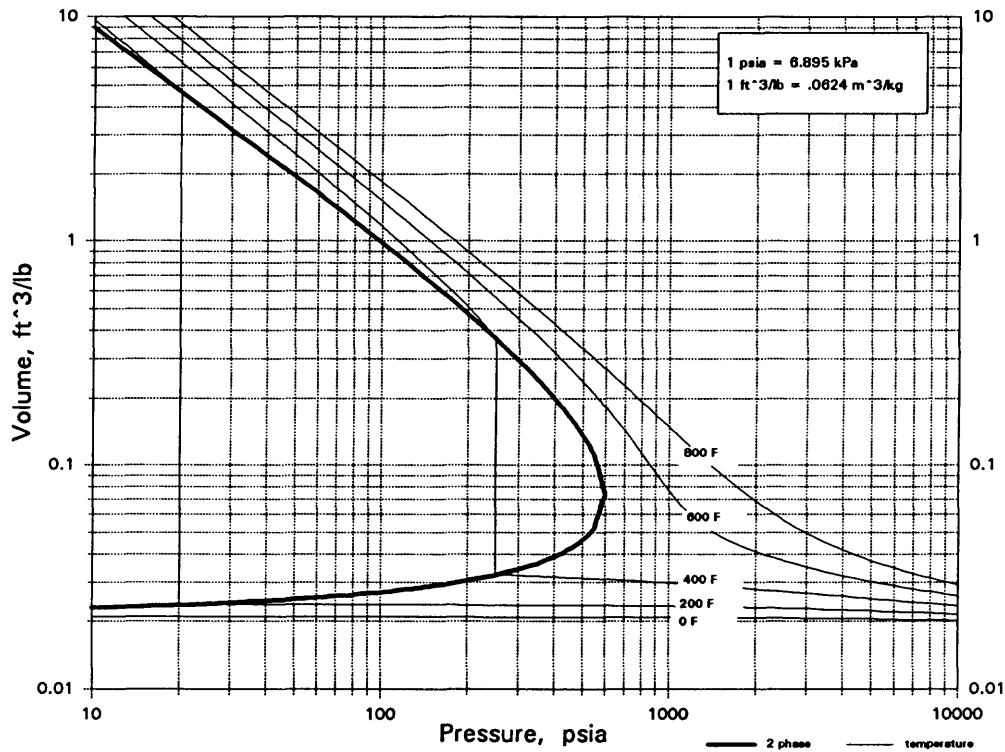


C4H8O

1-2-EPOXYBUTANE

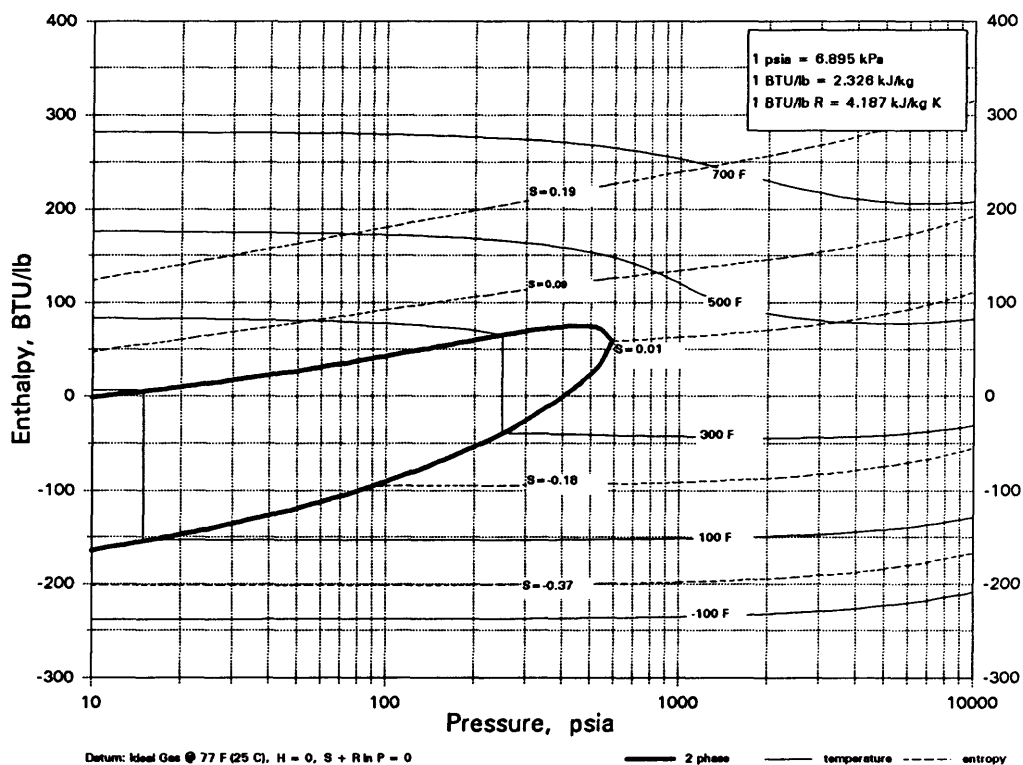
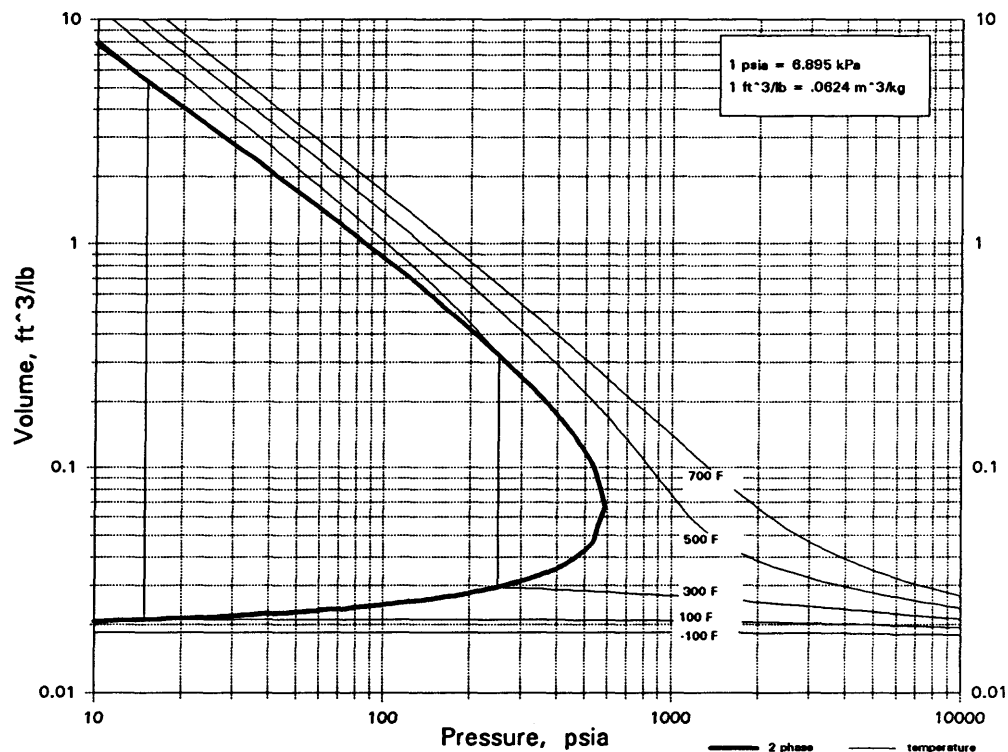


C4H8O
METHYL ETHYL KETONE



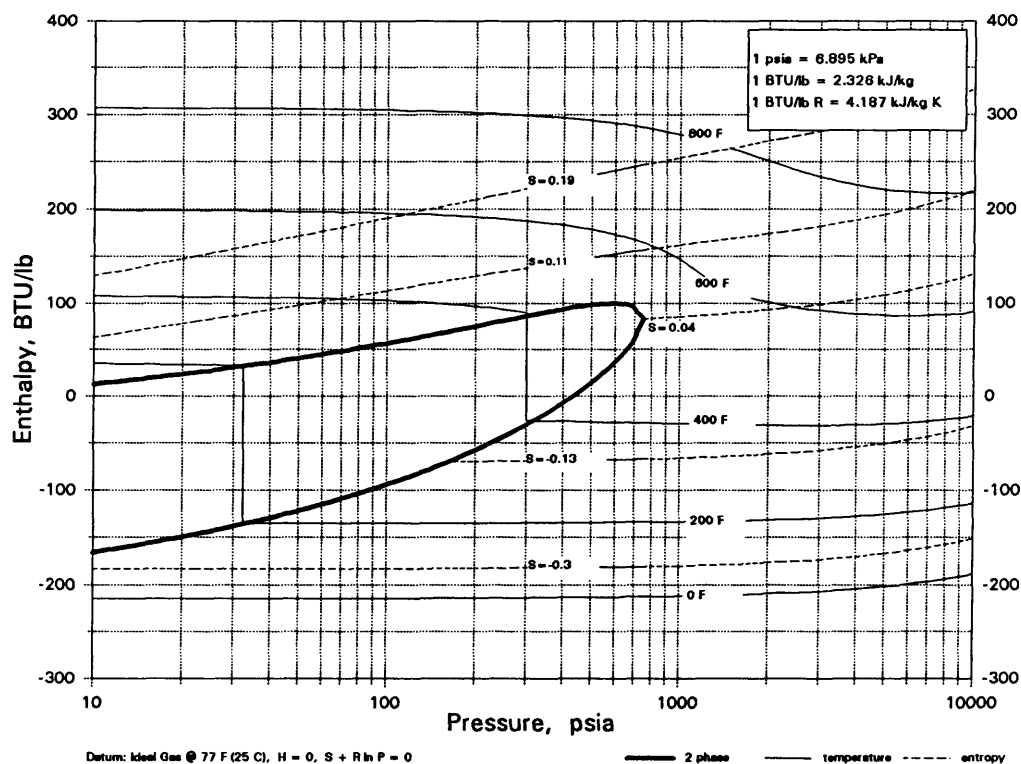
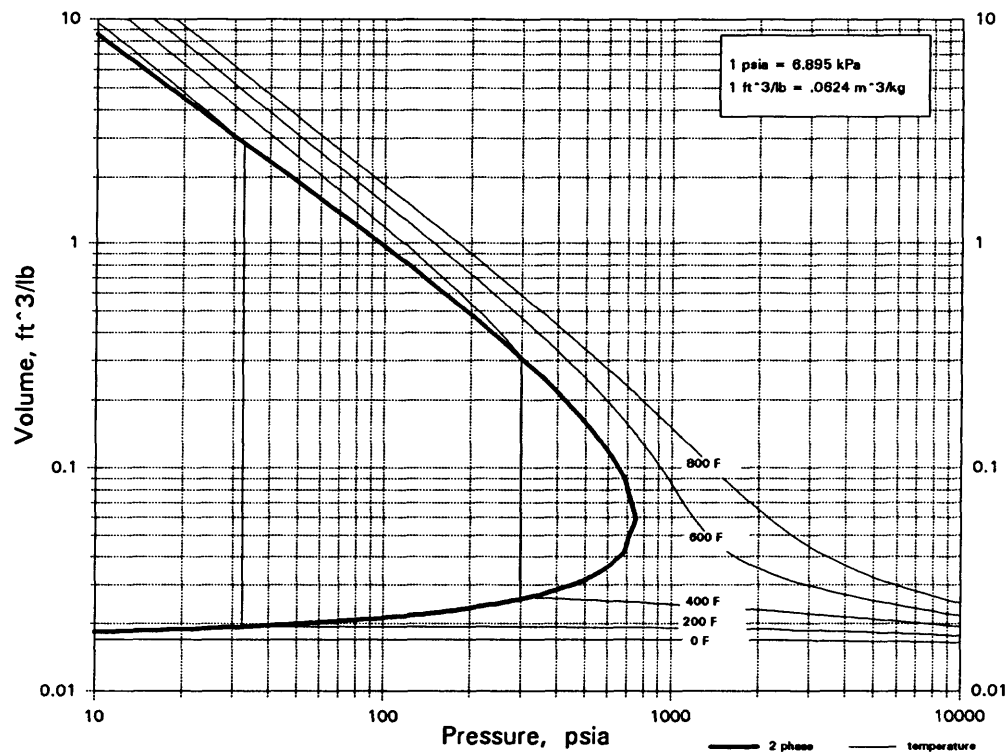
C4H8O

ETHYL VINYL ETHER



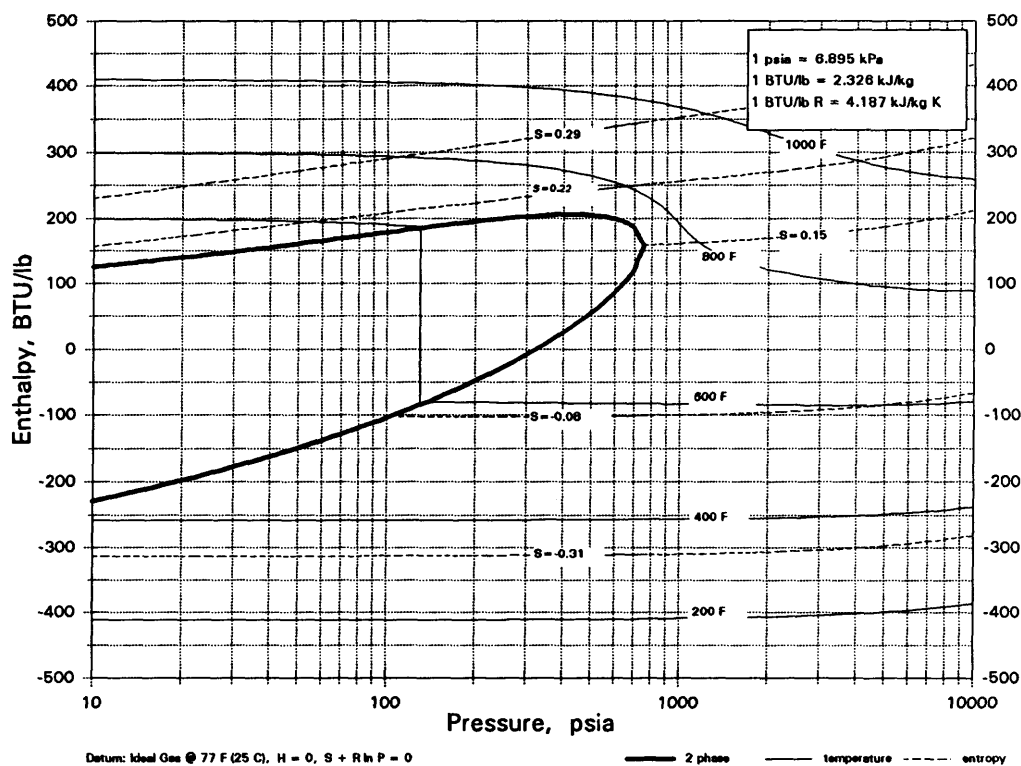
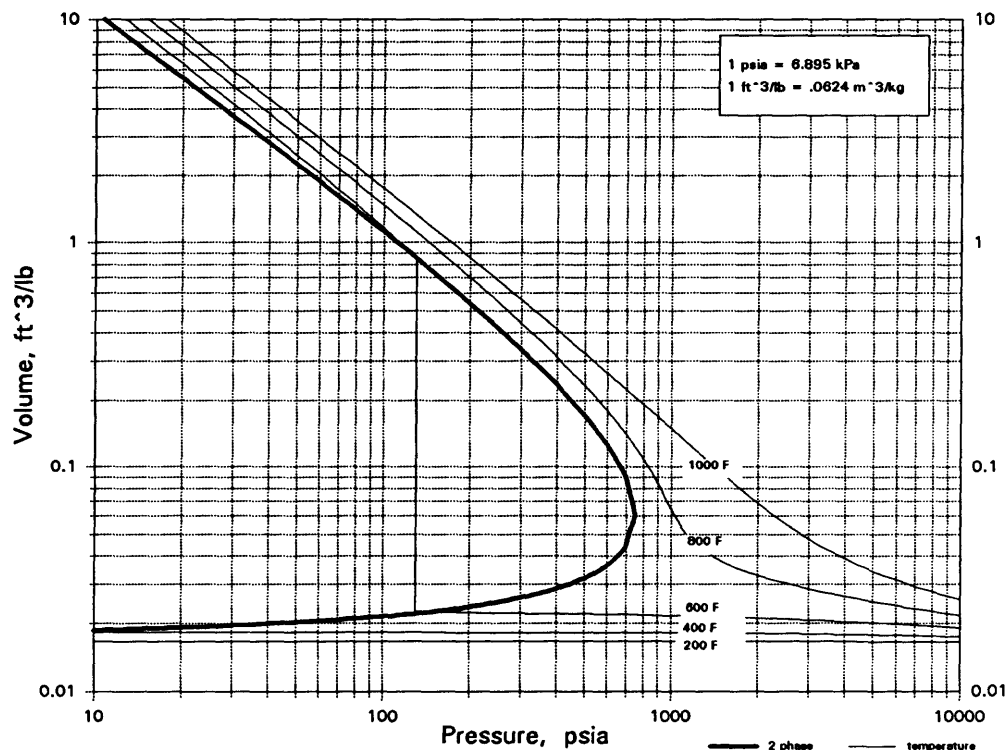
C4H8O

TETRAHYDROFURAN



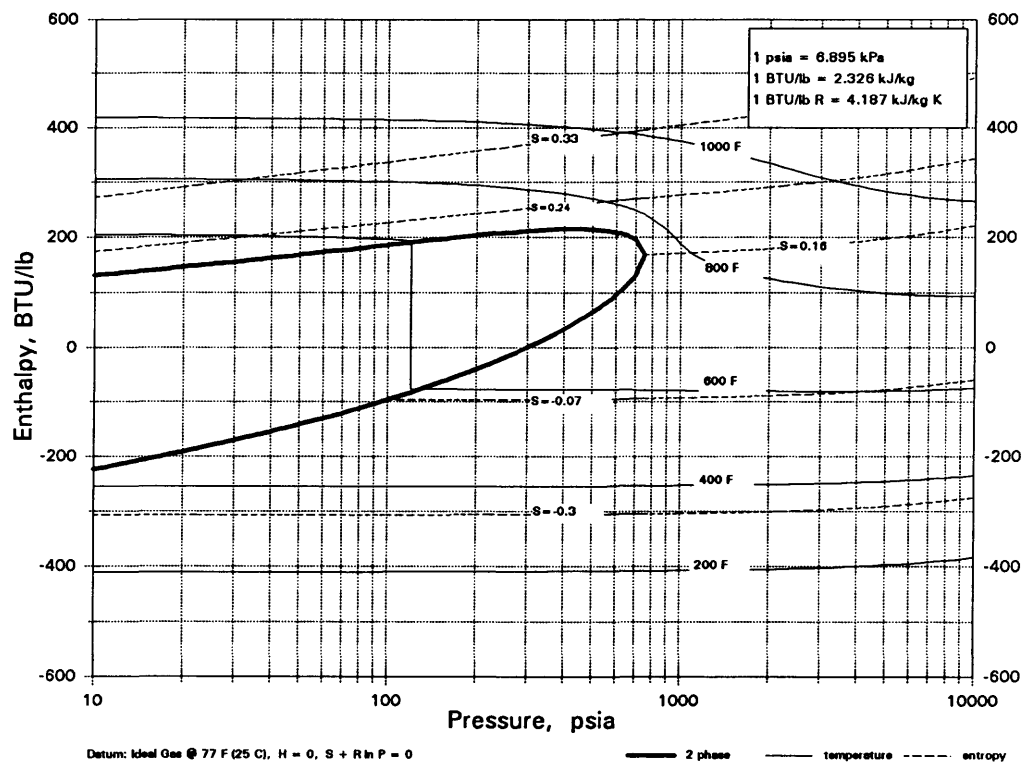
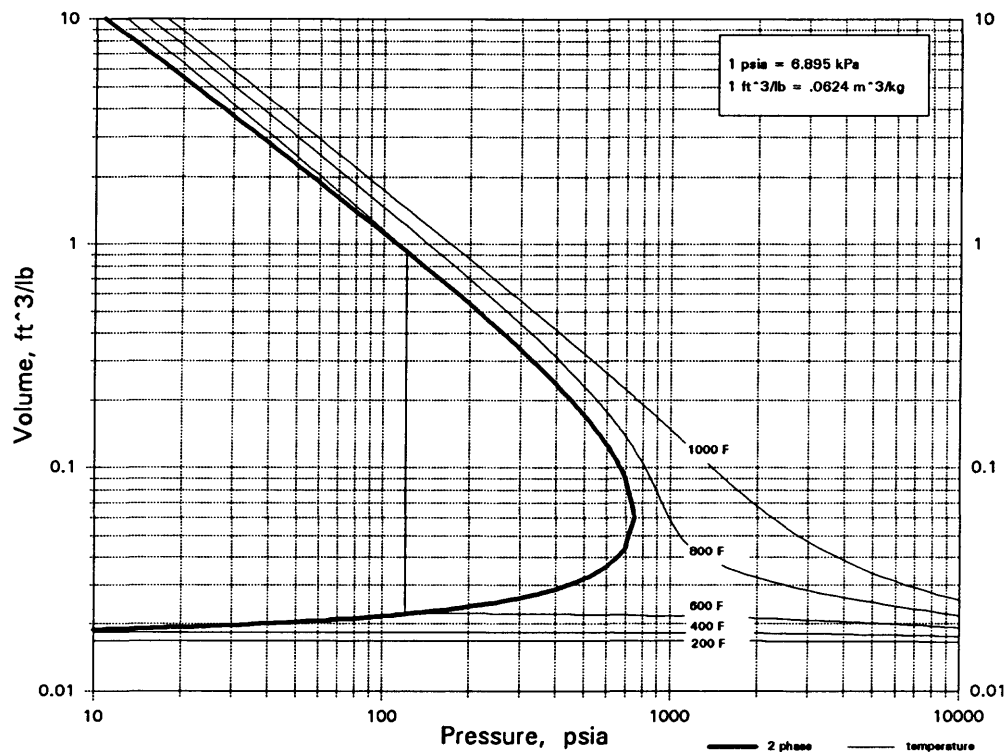
C4H8O2

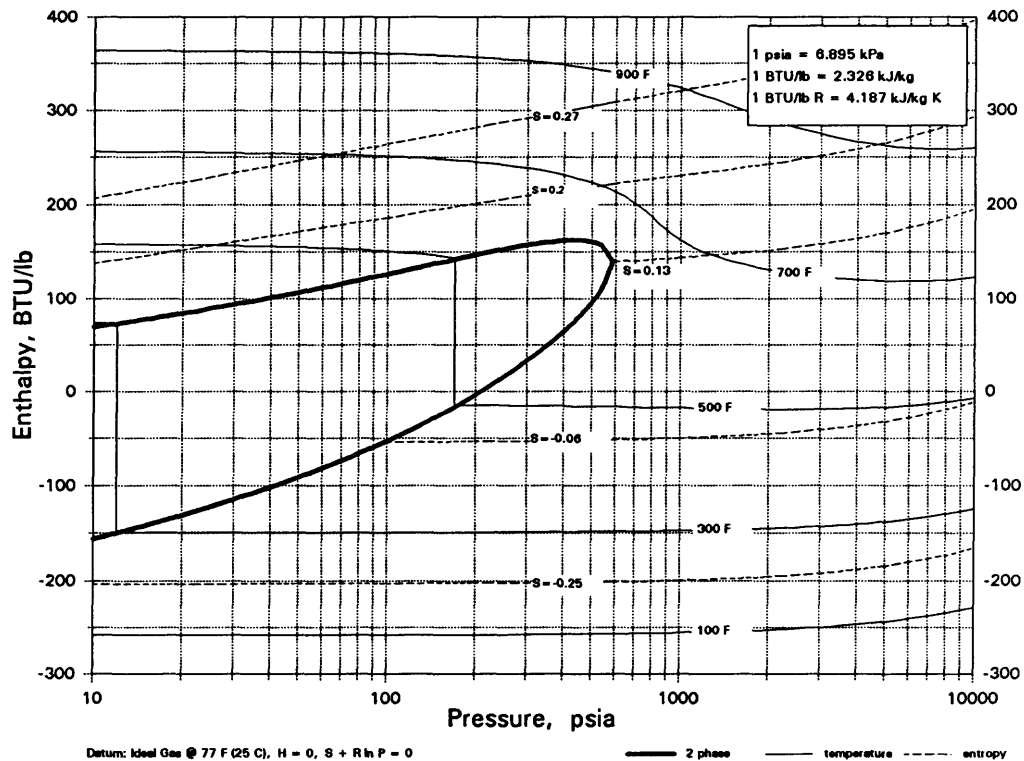
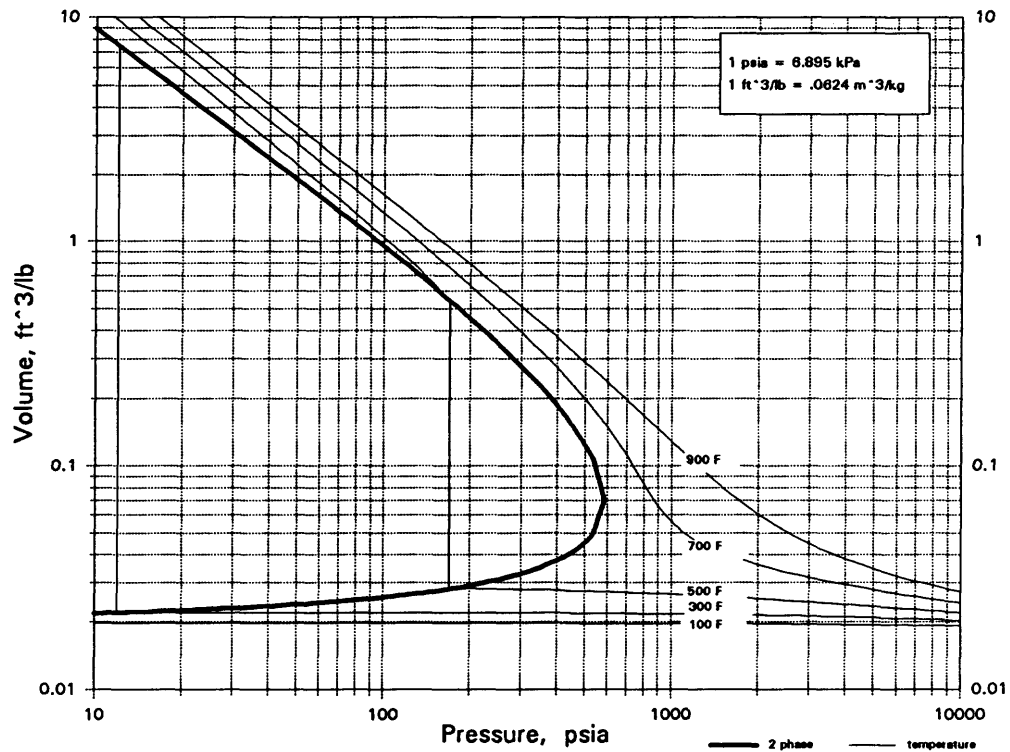
cis-2-BUTENE-1,4-DIOL



C4H8O2

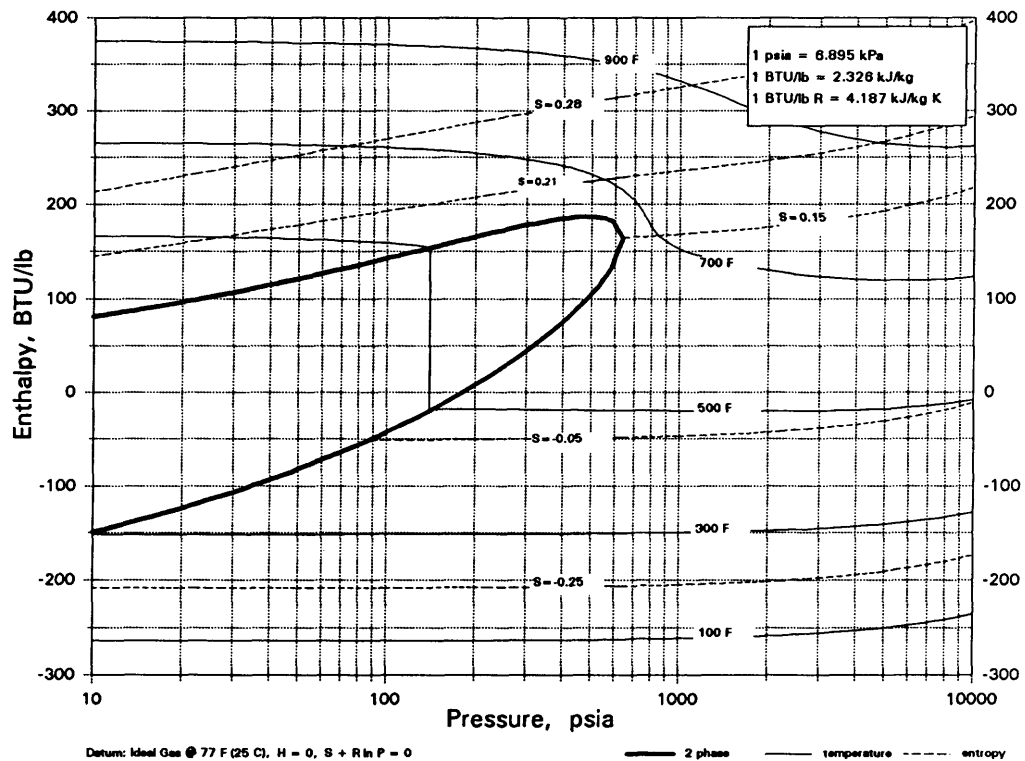
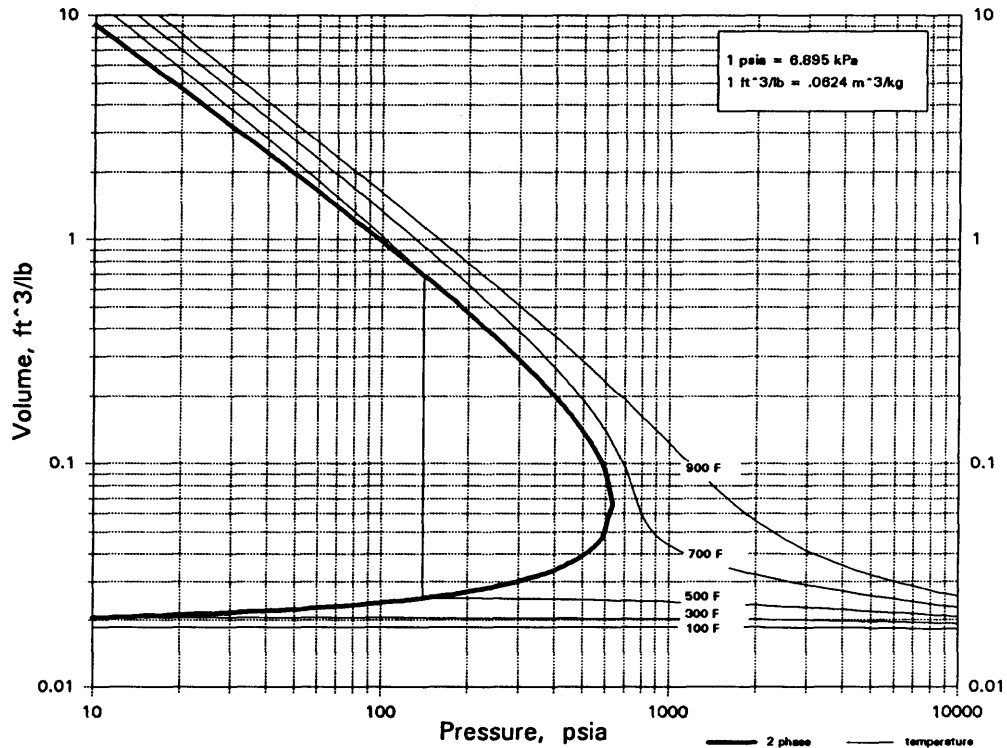
trans-2-BUTENE-1-4-DIOL



C4H8O2**ISOBUTYRIC ACID**

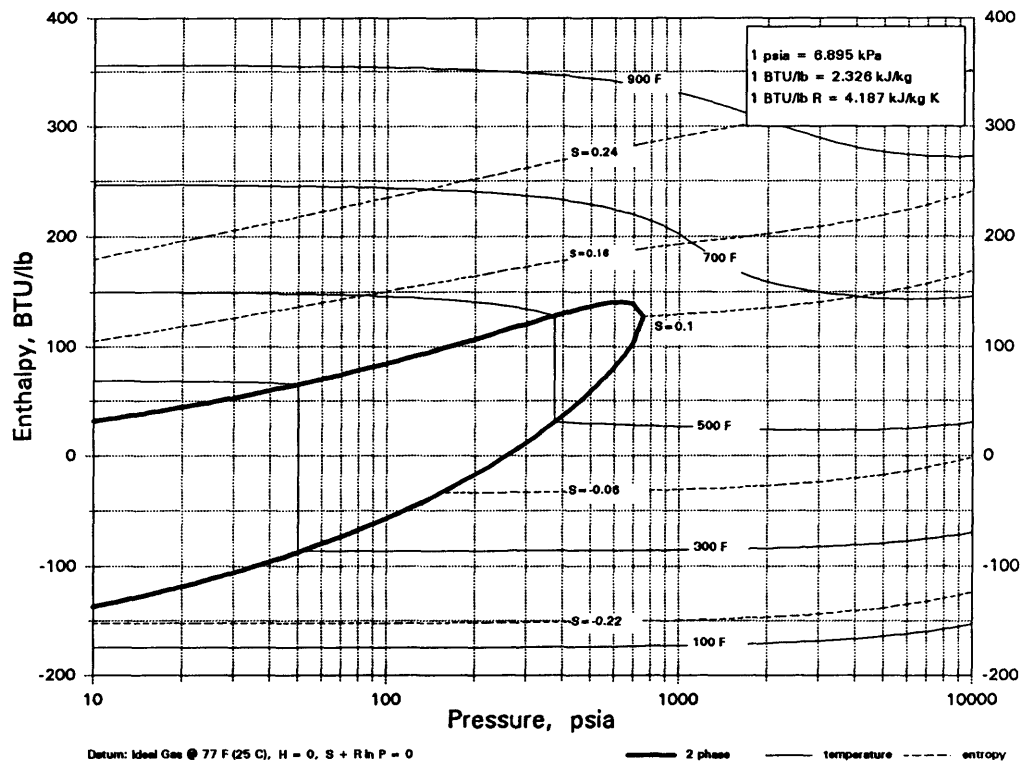
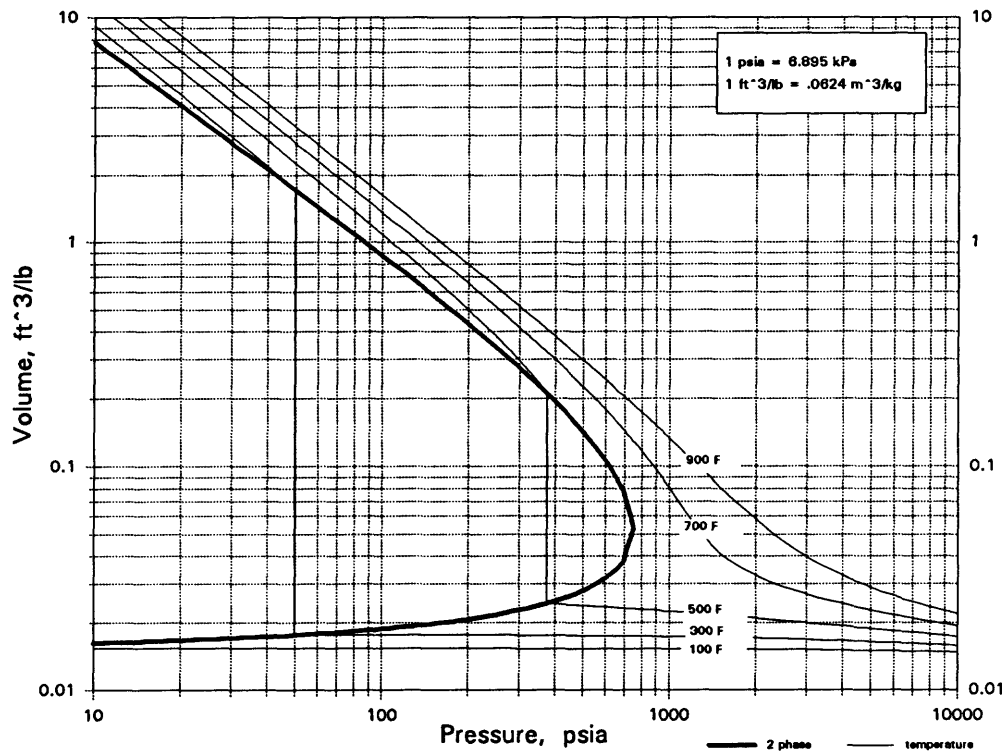
C4H8O2

n-BUTYRIC ACID

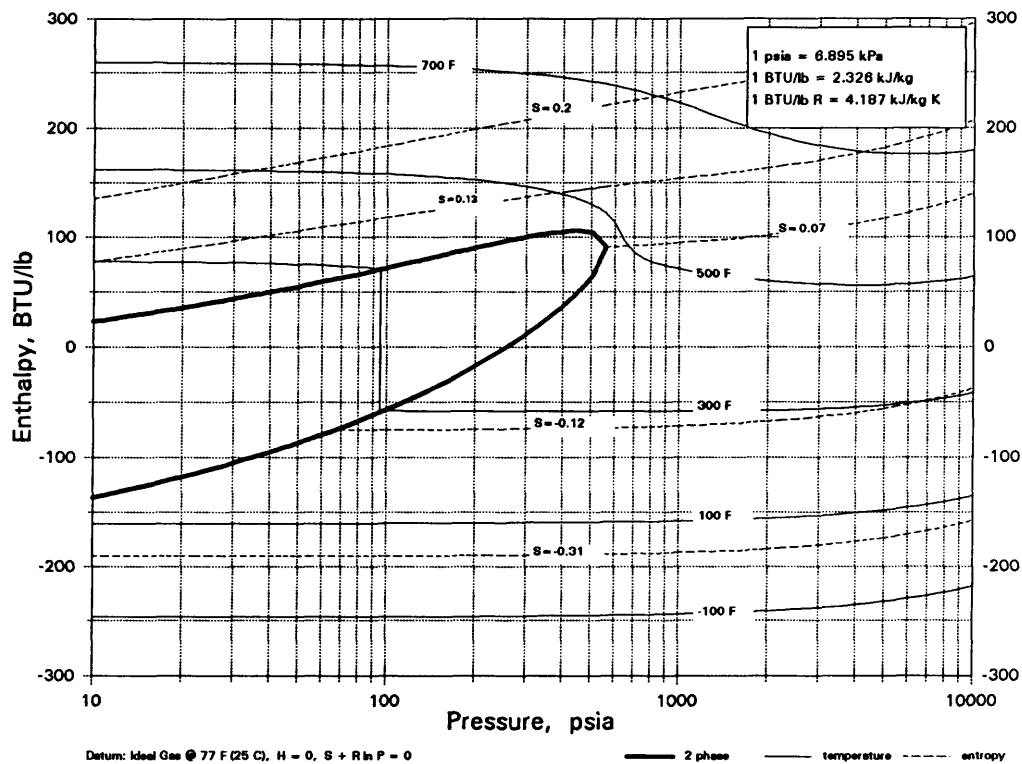
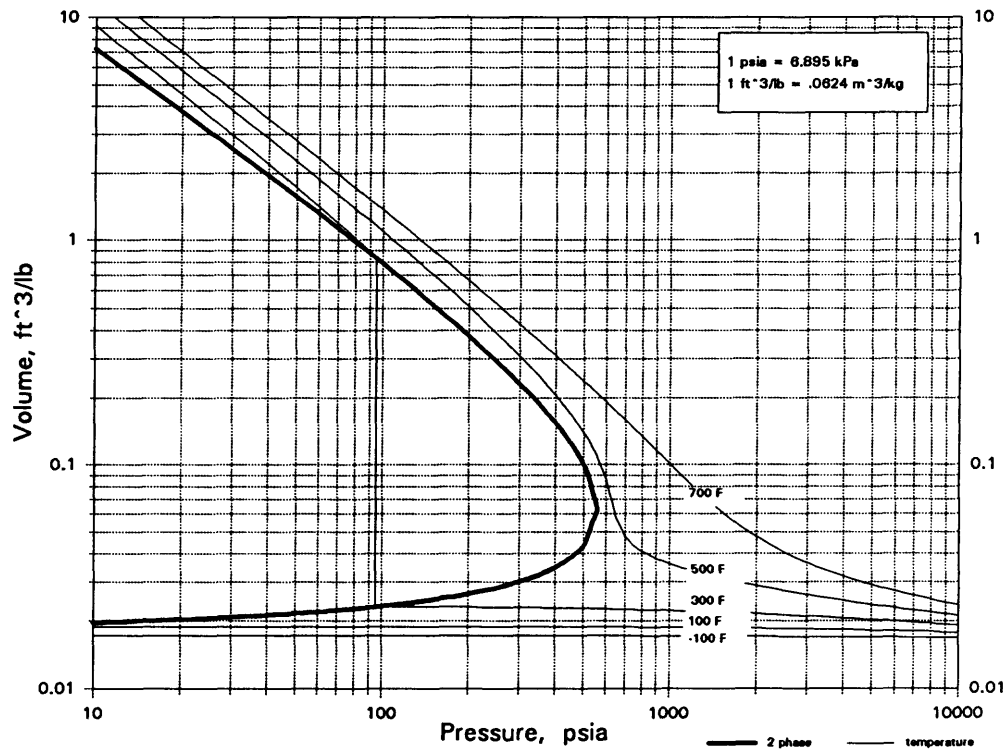


C4H8O2

1-4-DIOXANE

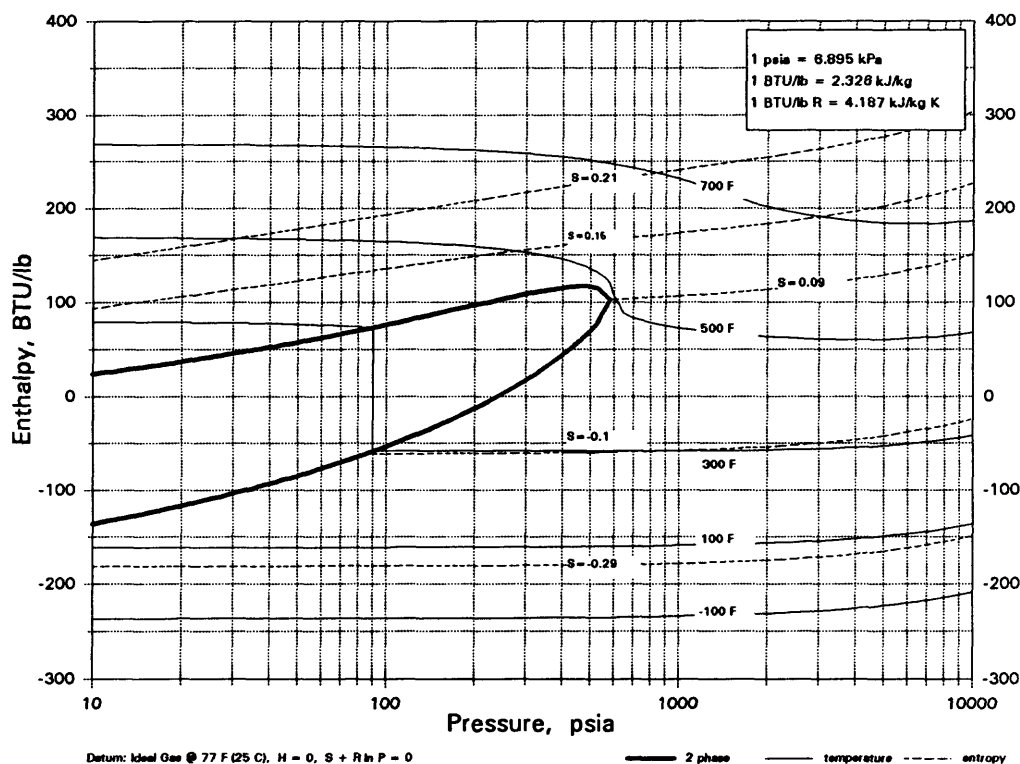
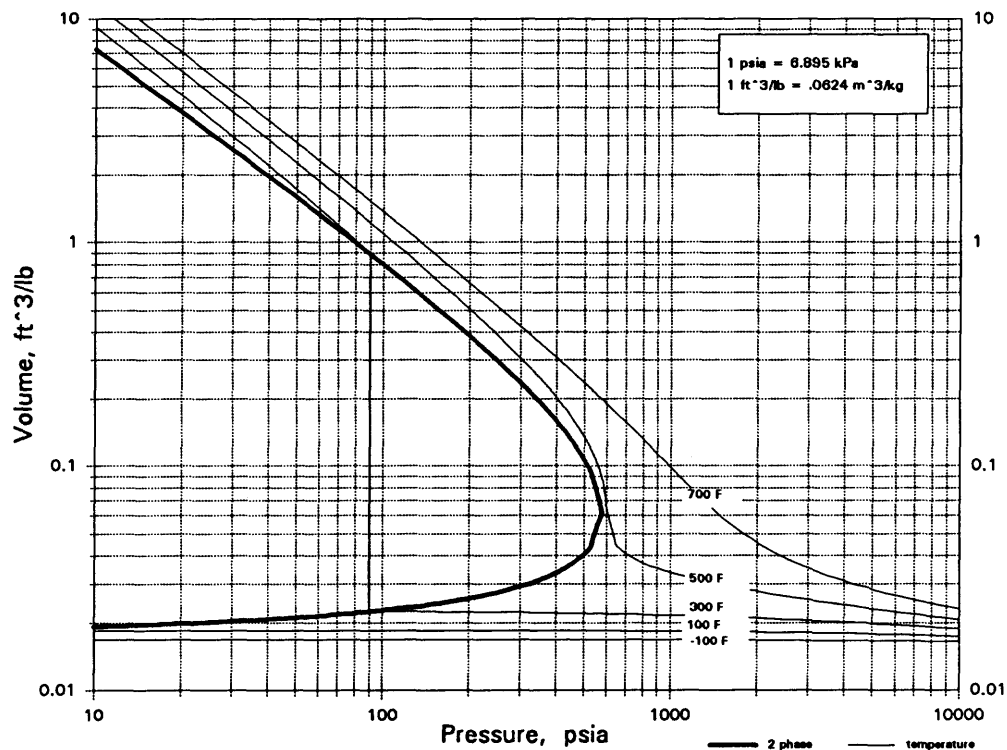


C4H8O2
ETHYL ACETATE

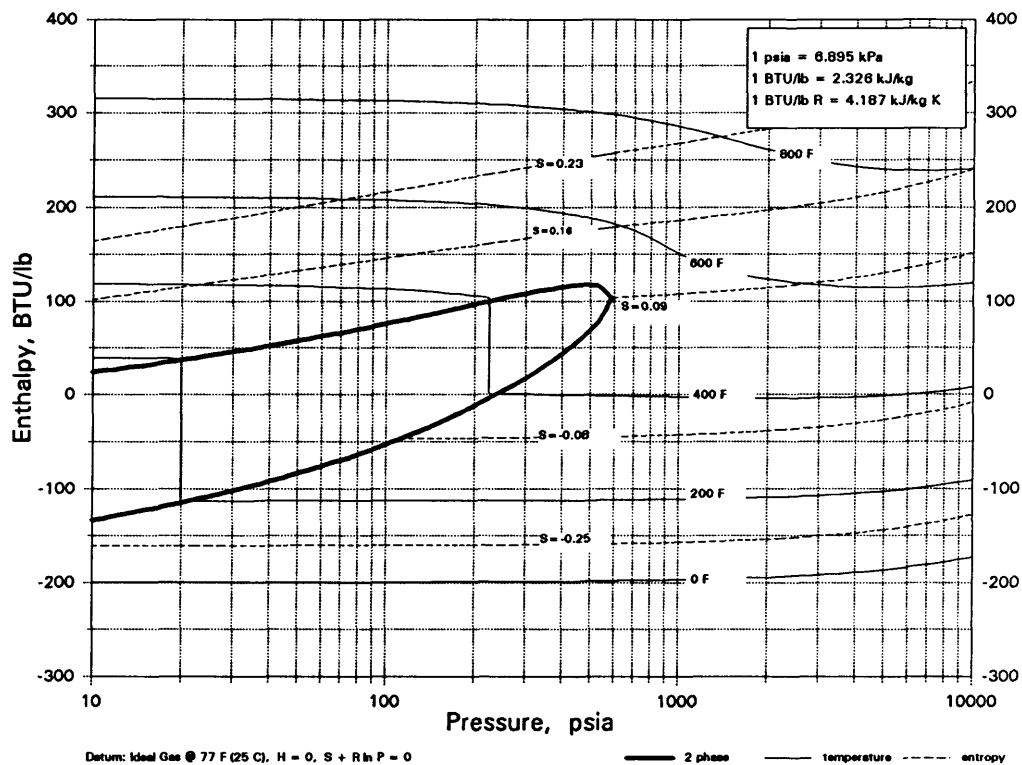
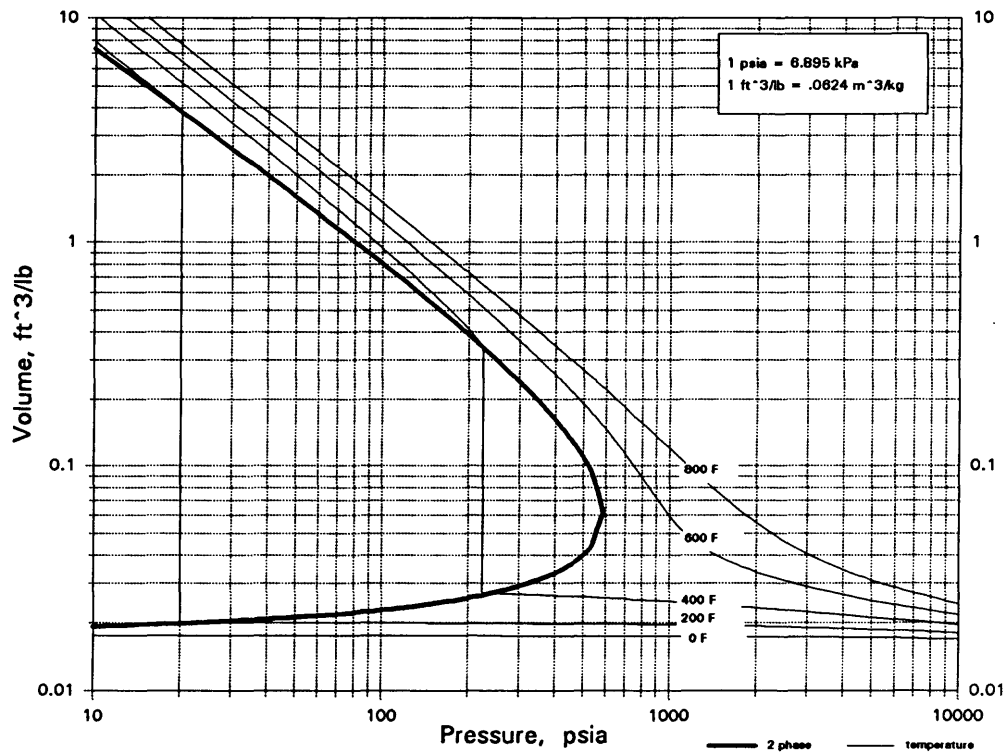


C4H8O2

METHYL PROPIONATE

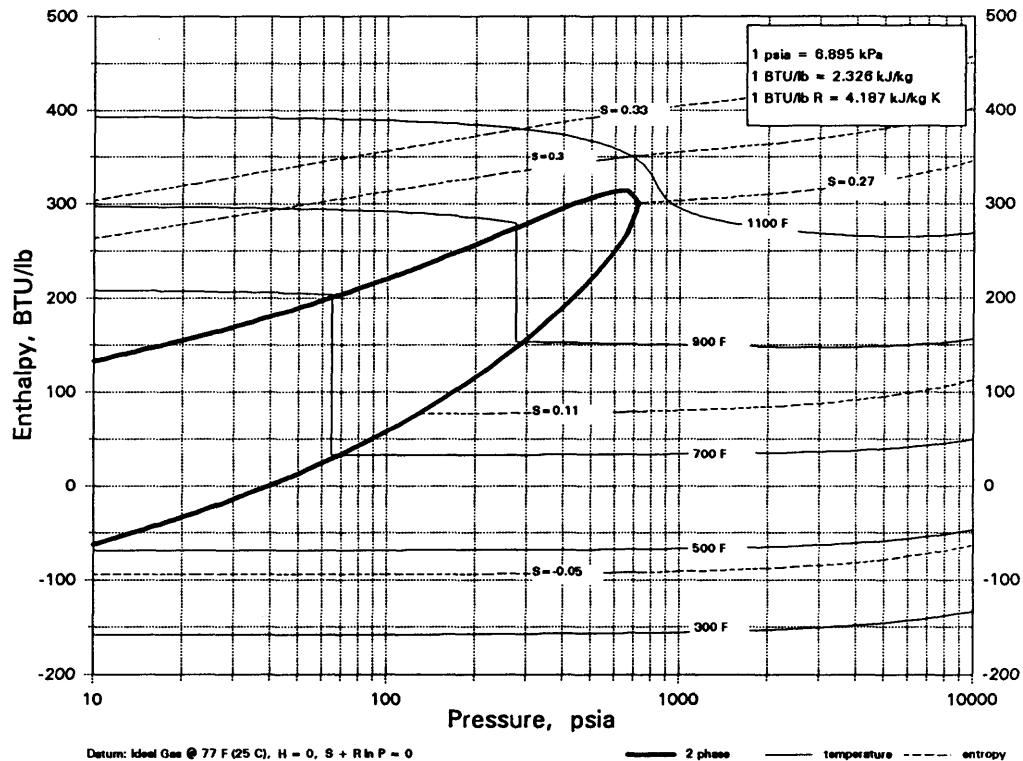
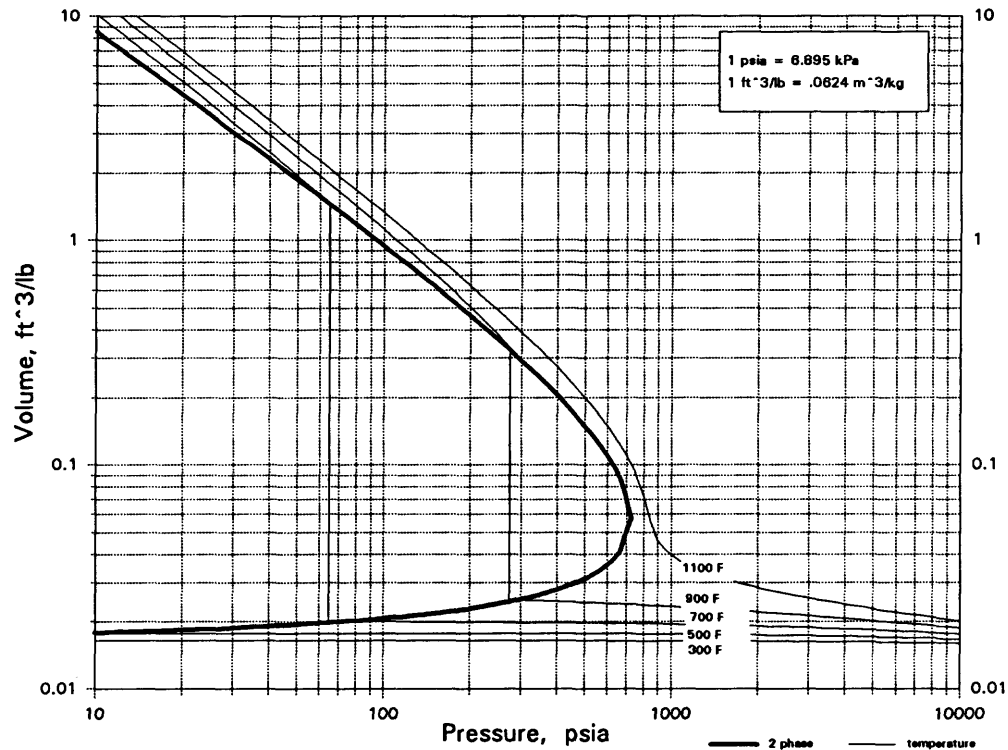


C4H8O2
n-PROPYL FORMATE



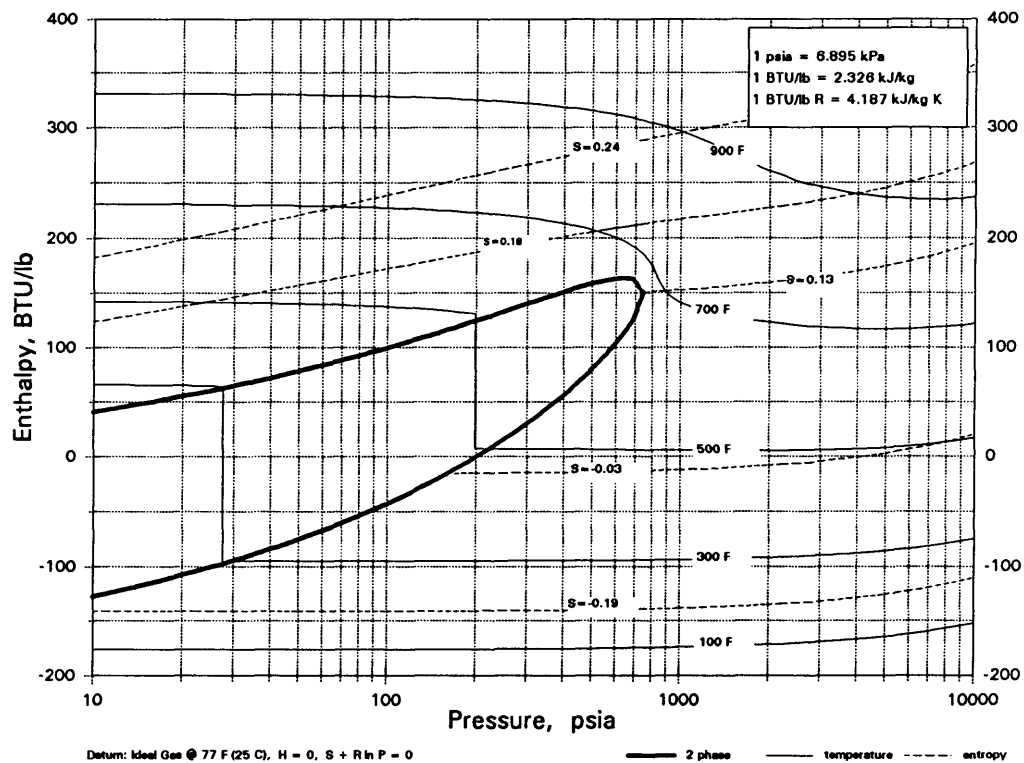
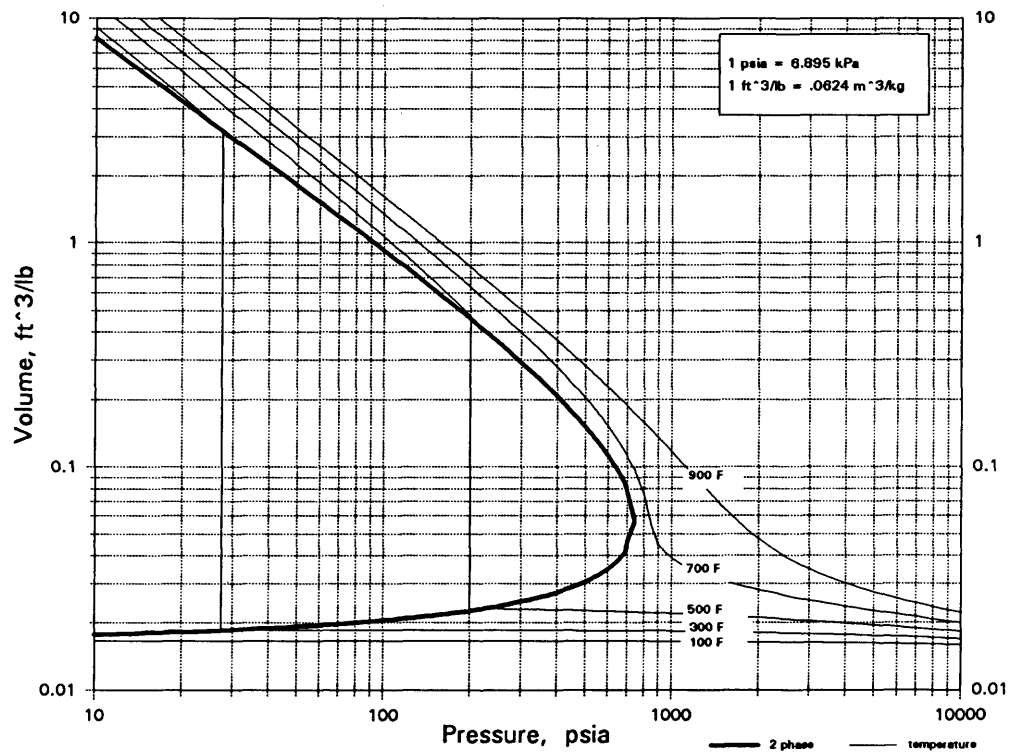
C4H8O2S

SULFOLANE



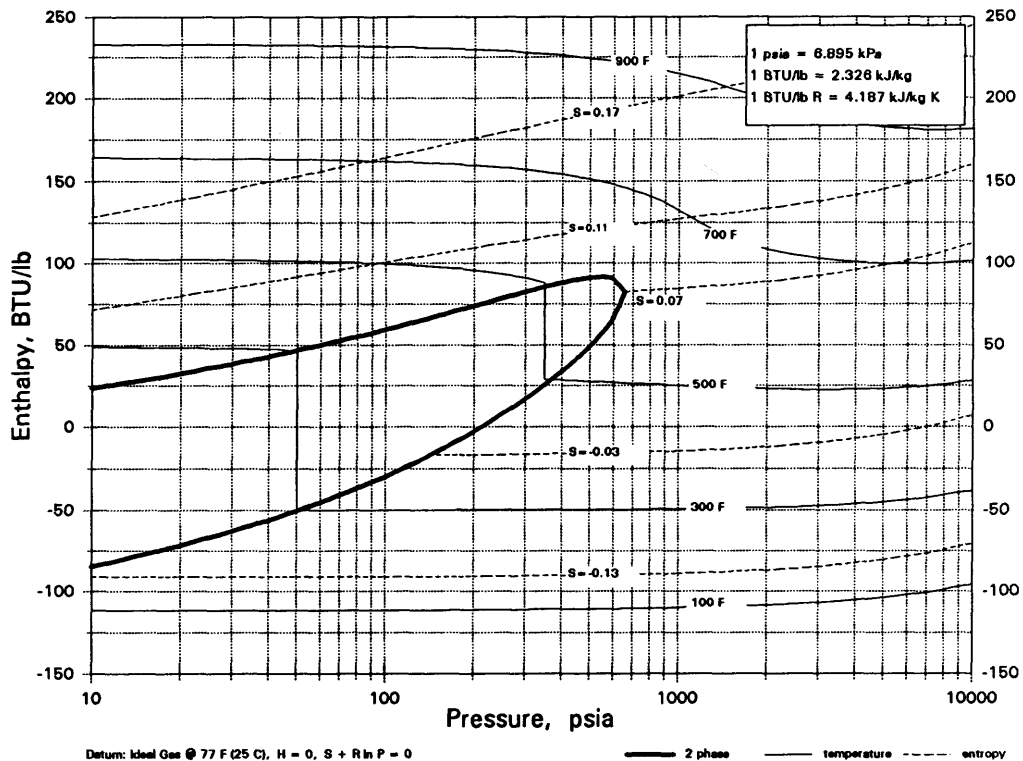
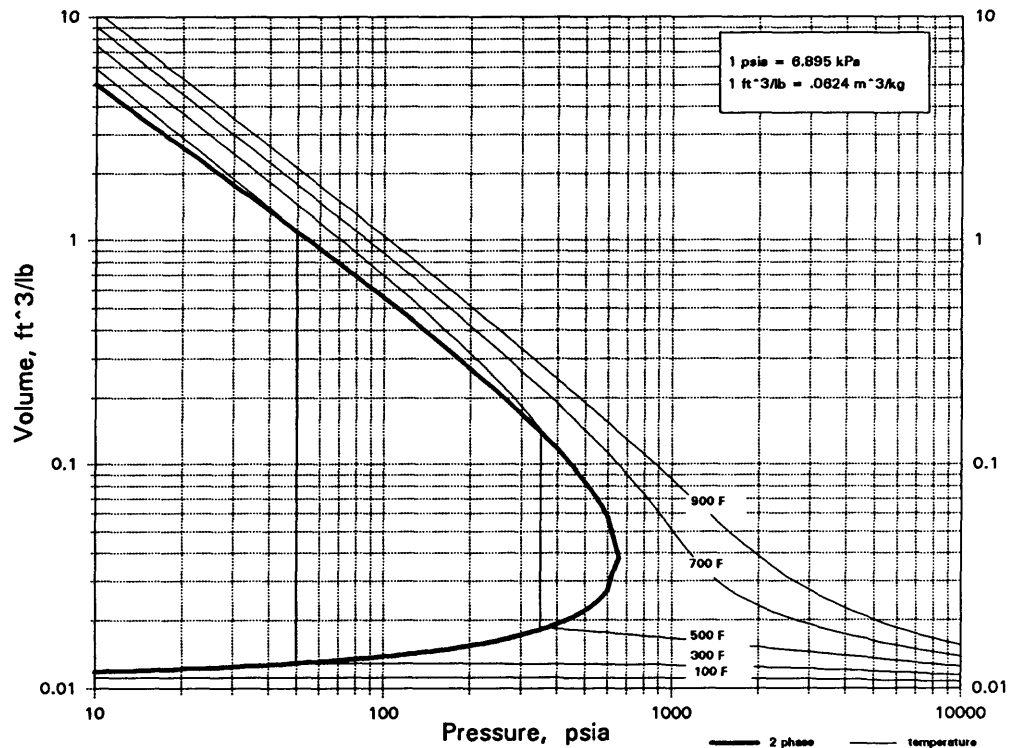
C4H8S

TETRAHYDROTHIOPHENE



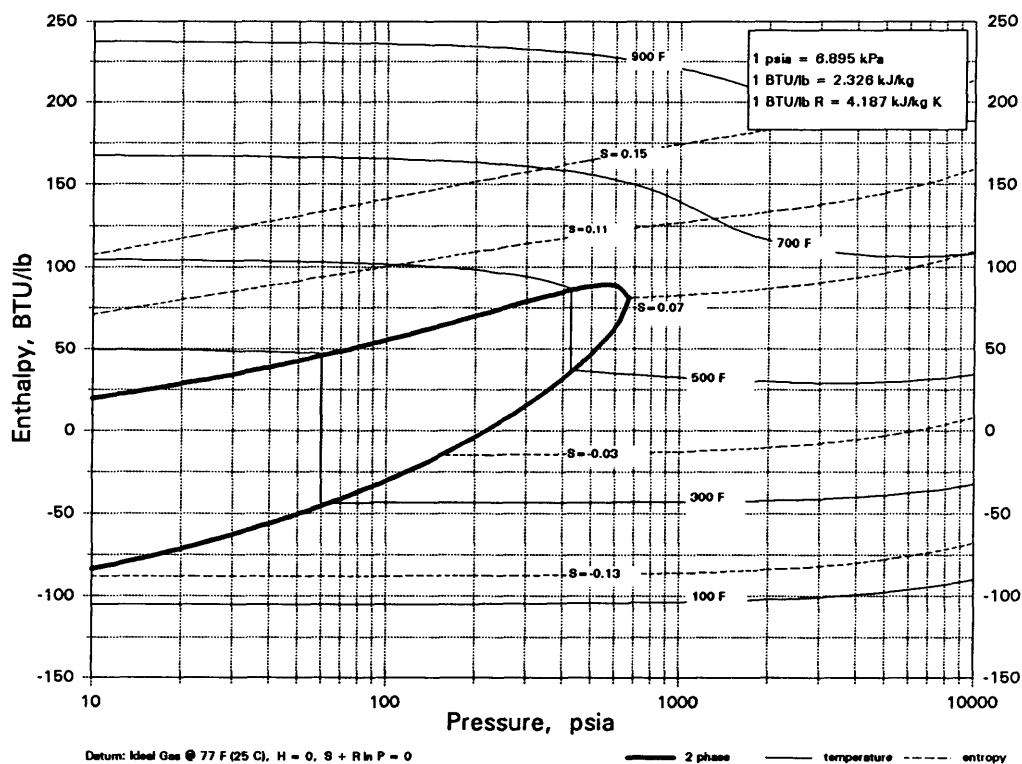
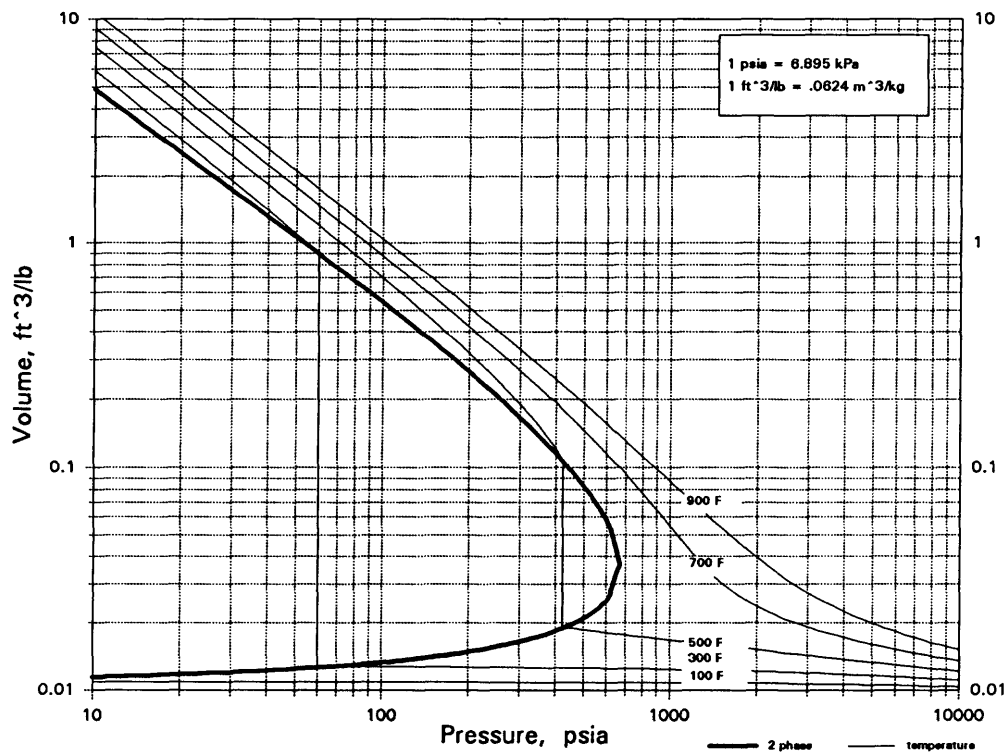
C4H9Br

1-BROMOBUTANE



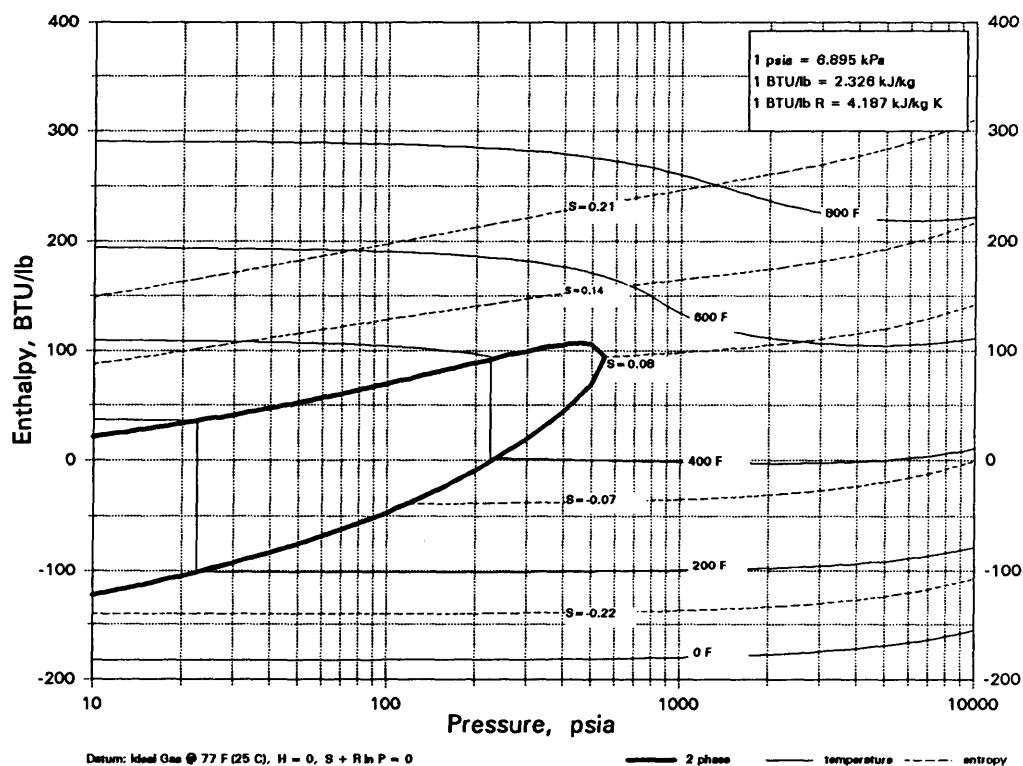
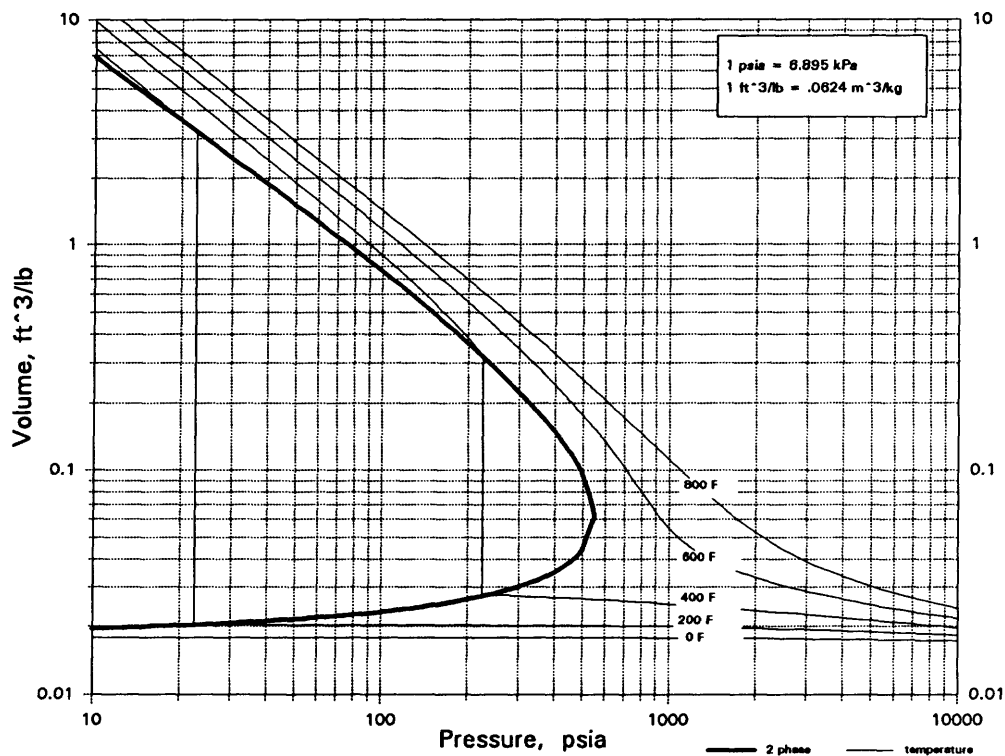
C₄H₉Br

2-BROMOBUTANE



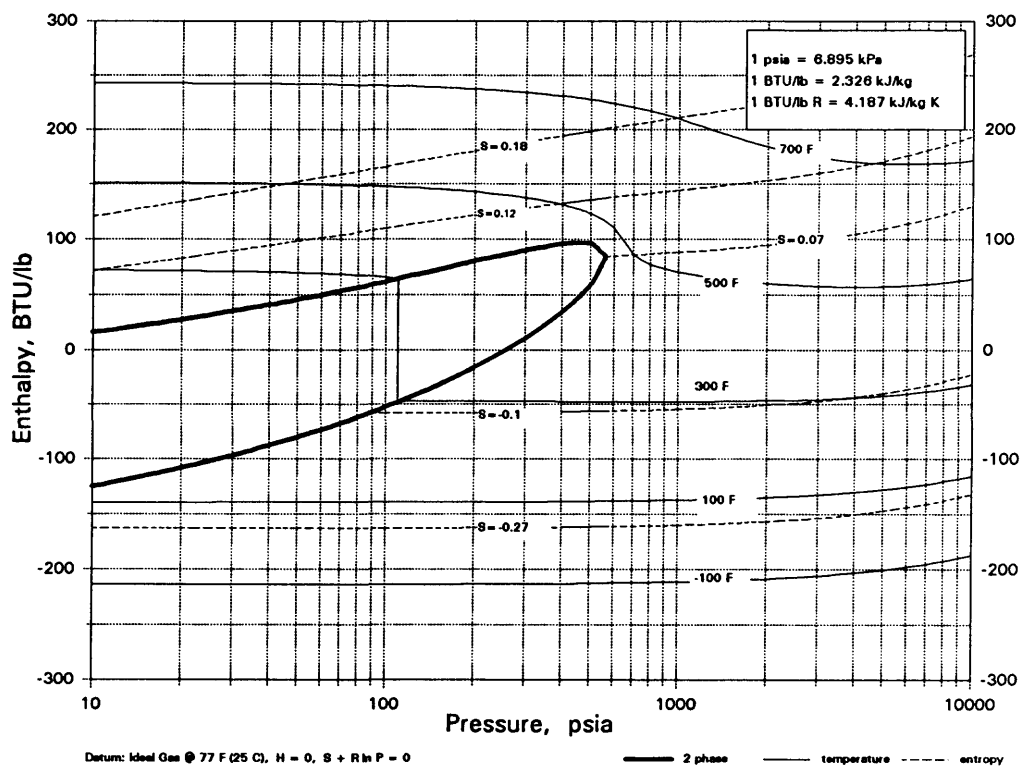
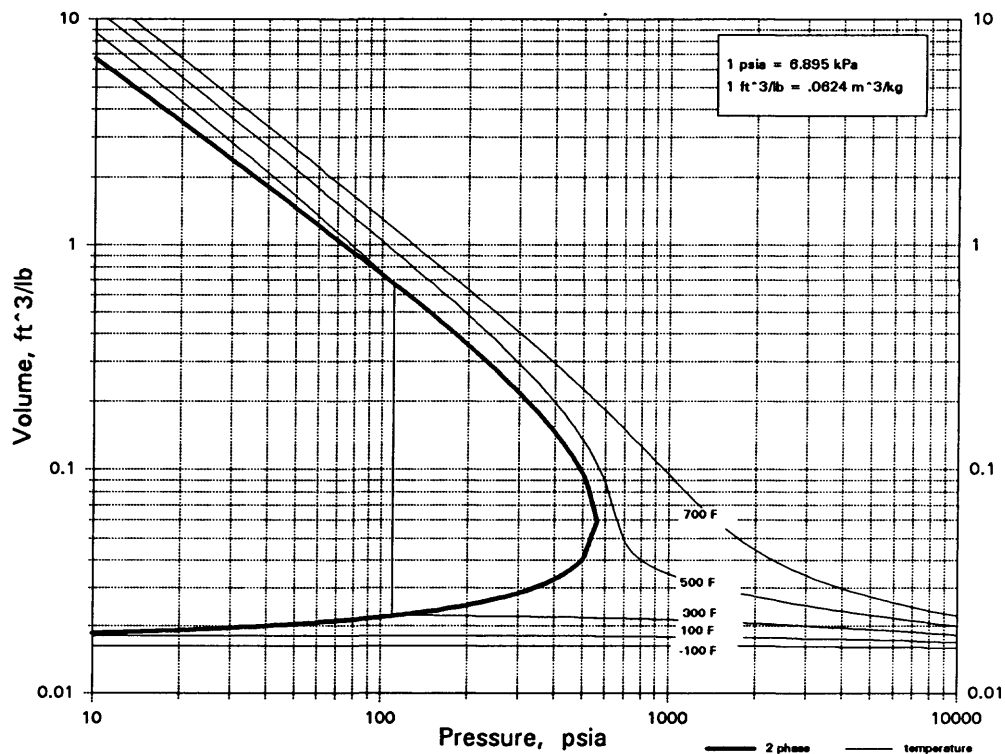
C₄H₉Cl

n-BUTYL CHLORIDE



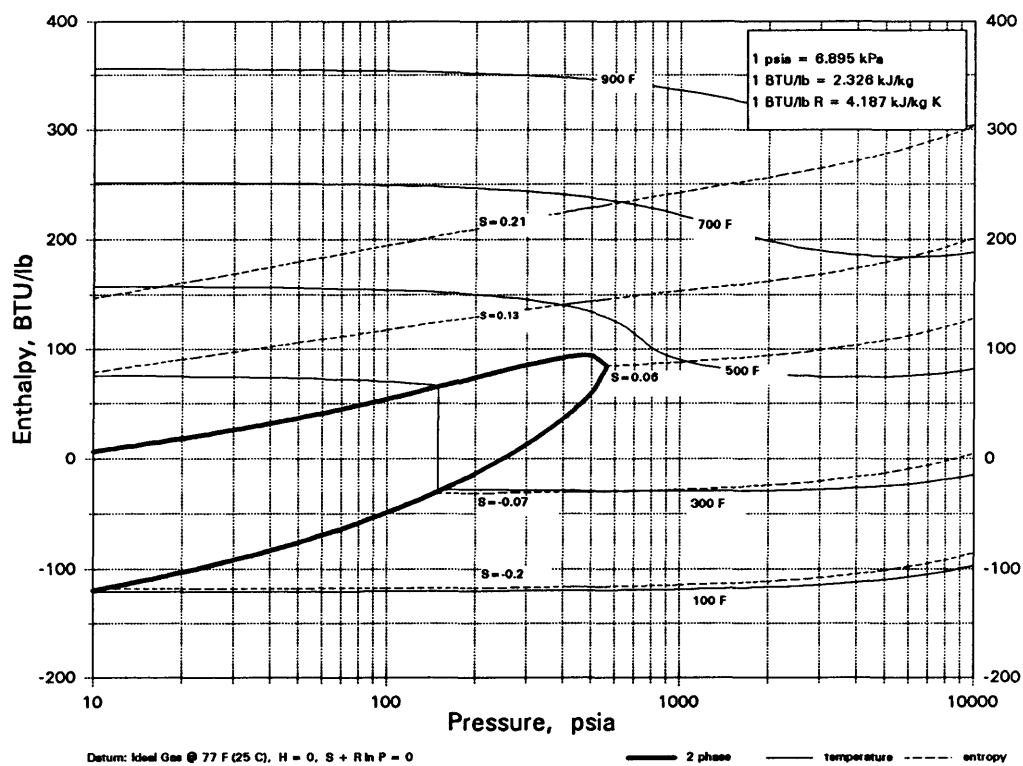
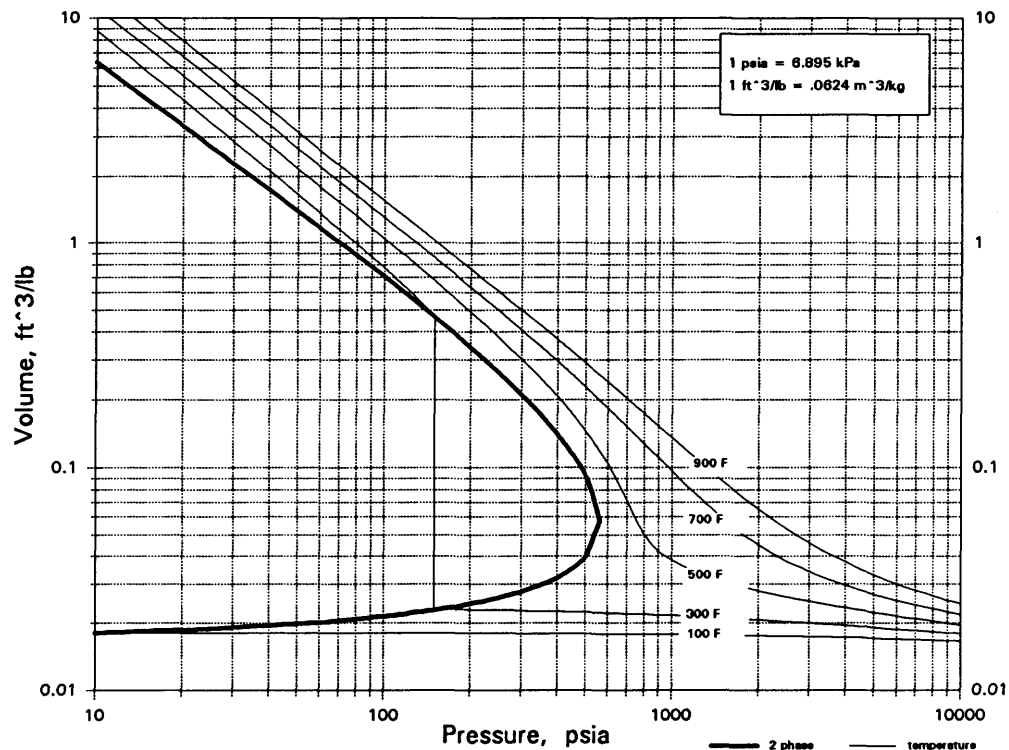
C4H9Cl

sec-BUTYL CHLORIDE

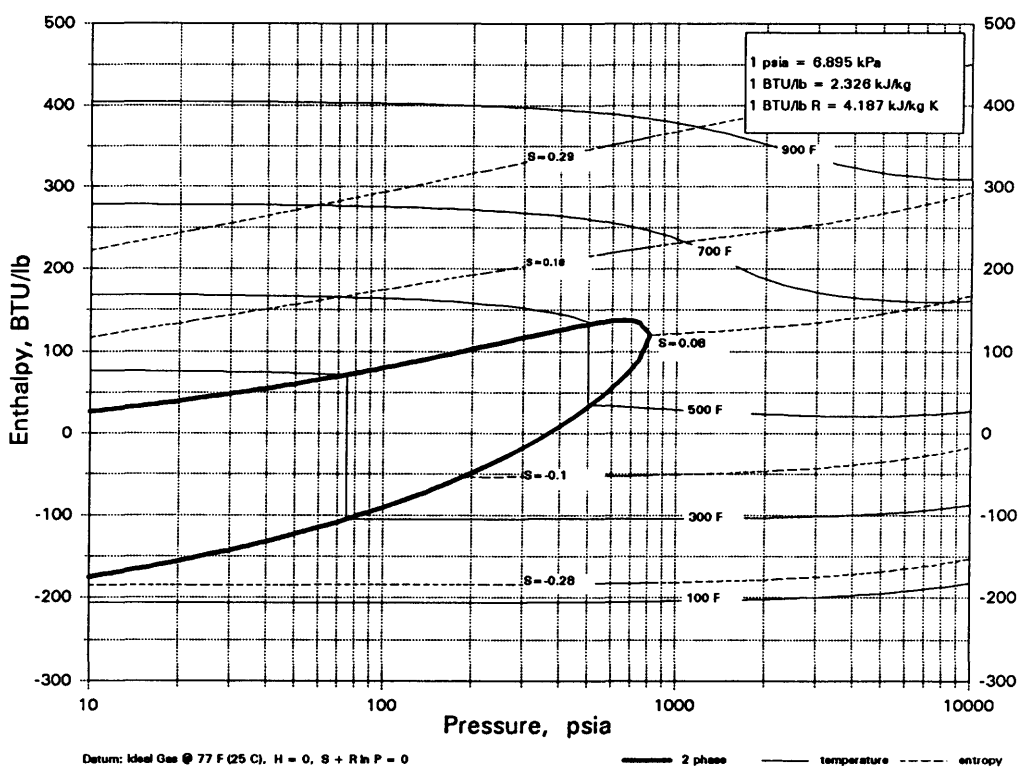
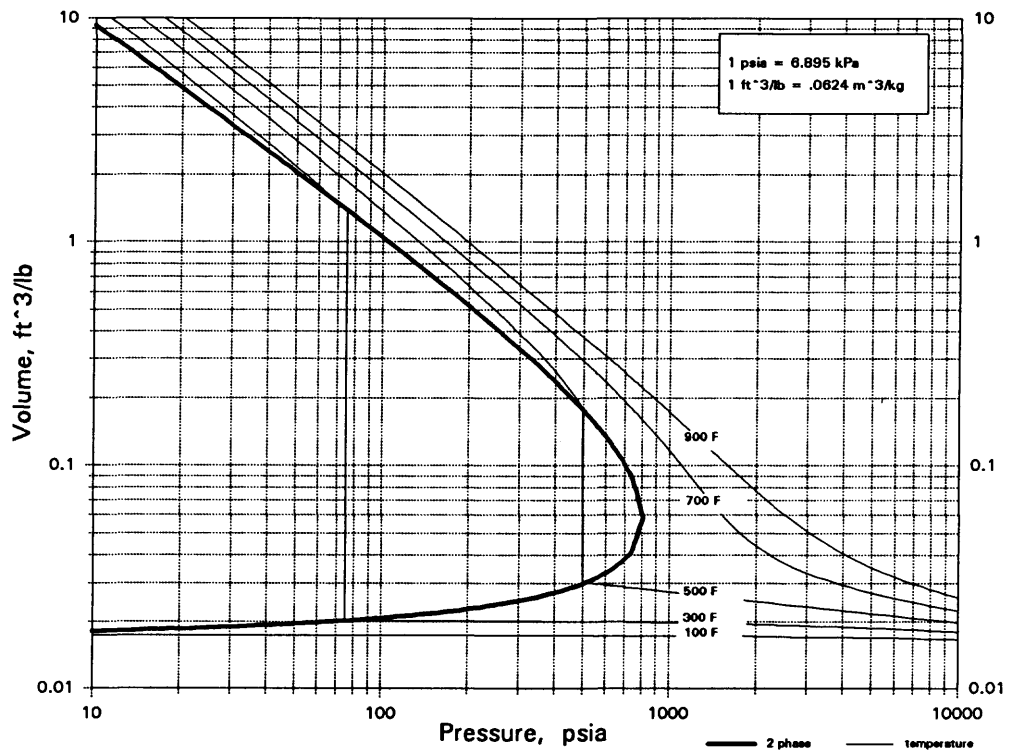


C4H9Cl

tert-BUTYL CHLORIDE

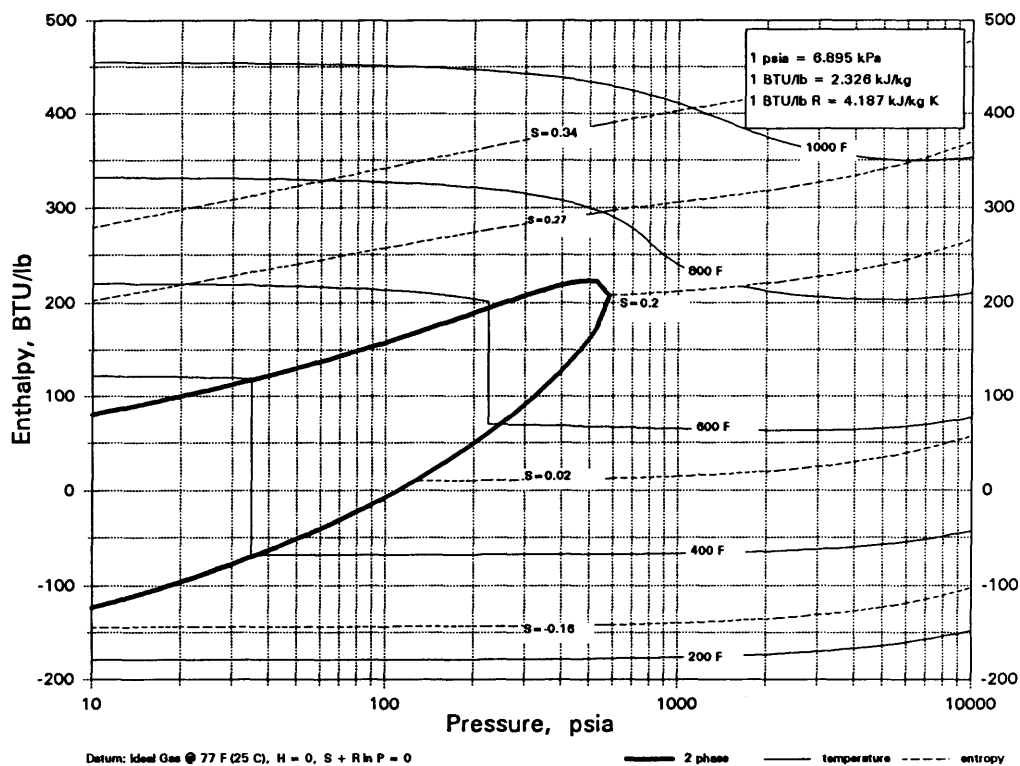
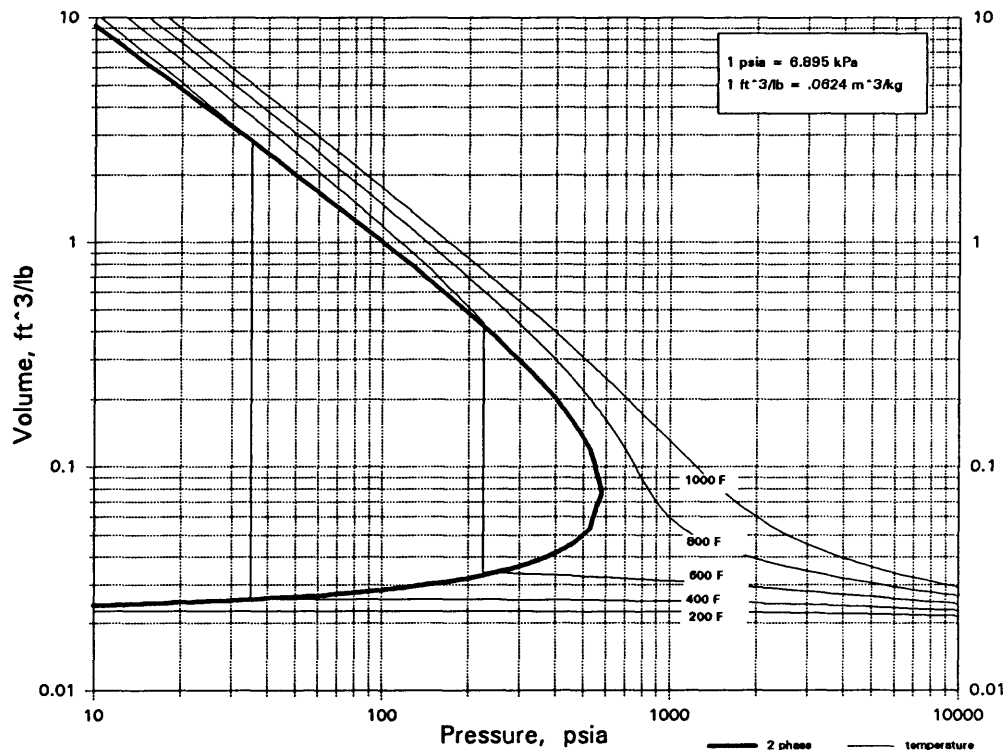


C4H9N
PYRROLIDINE



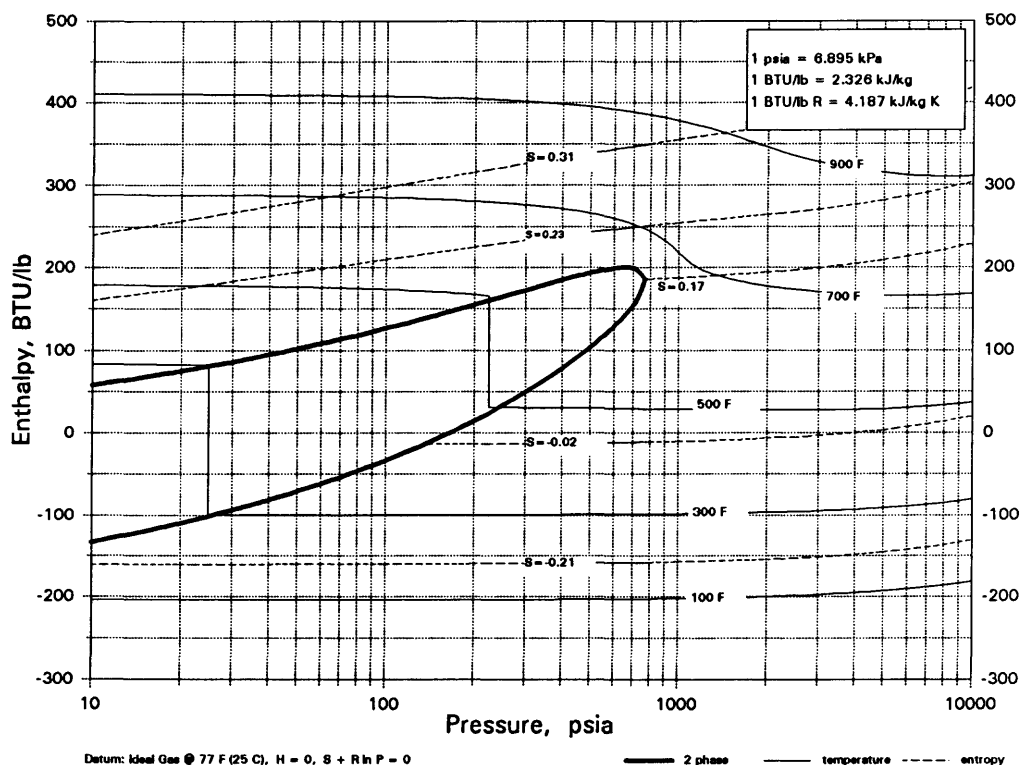
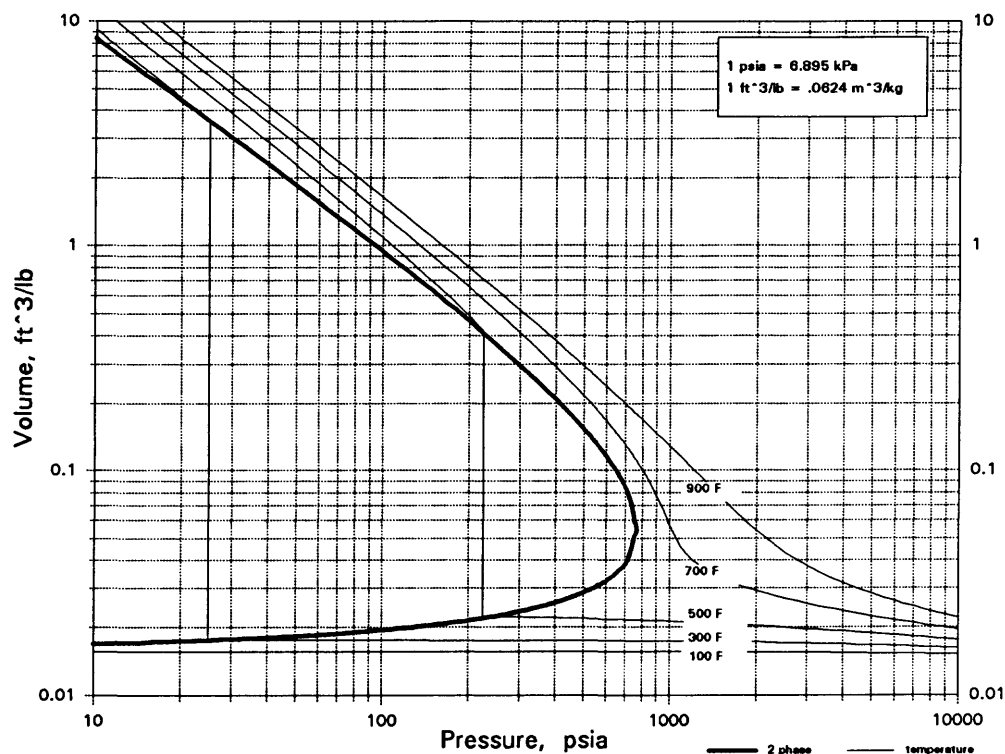
C4H9NO

N-N-DIMETHYLACETAMIDE

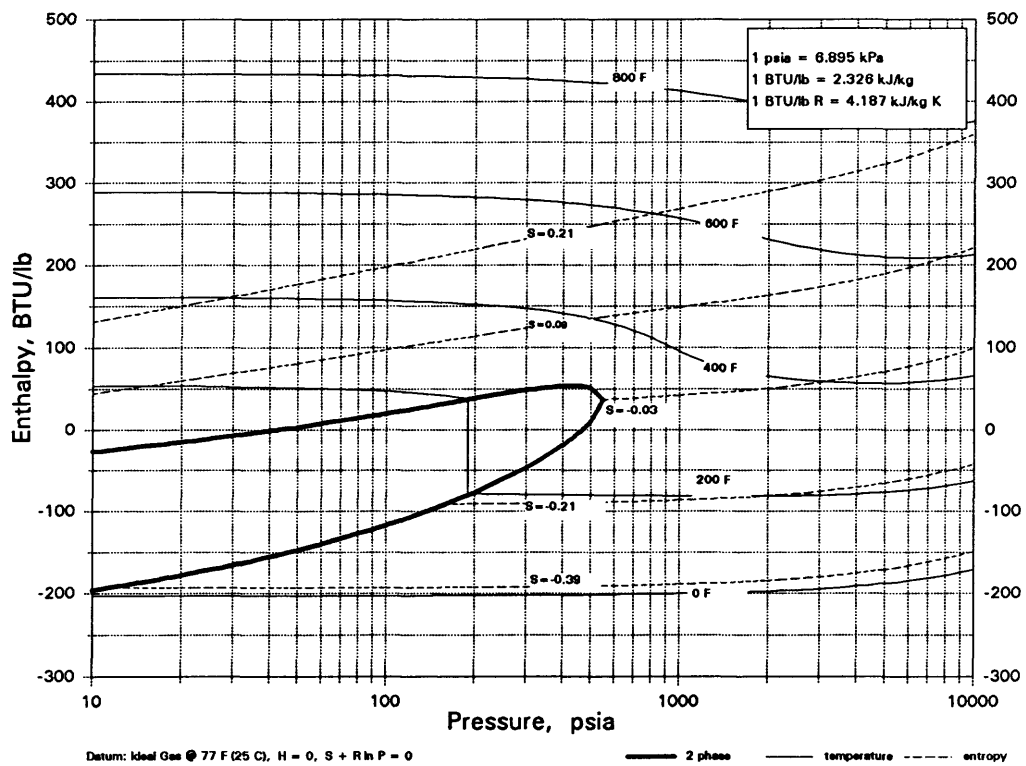
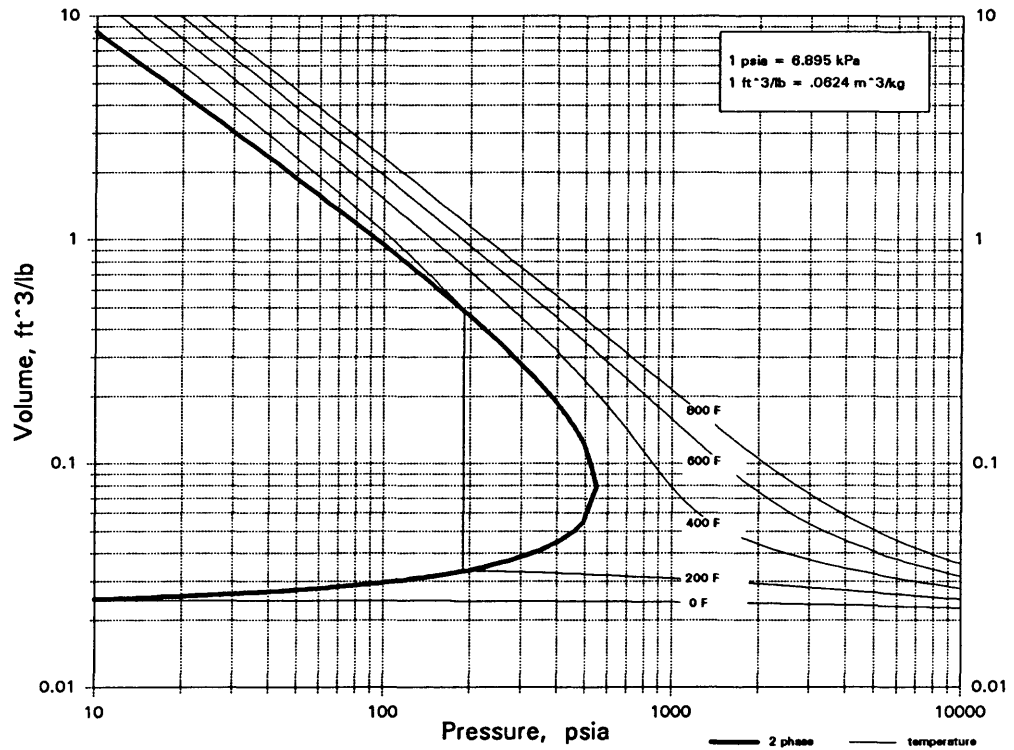


C₄H₉NO

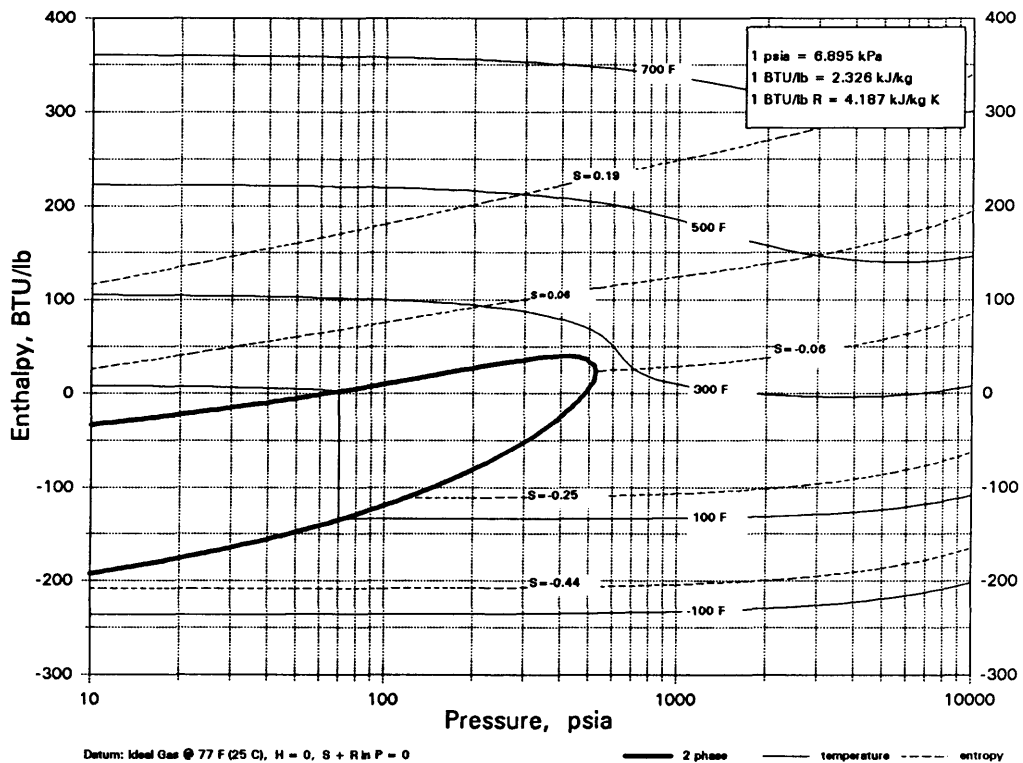
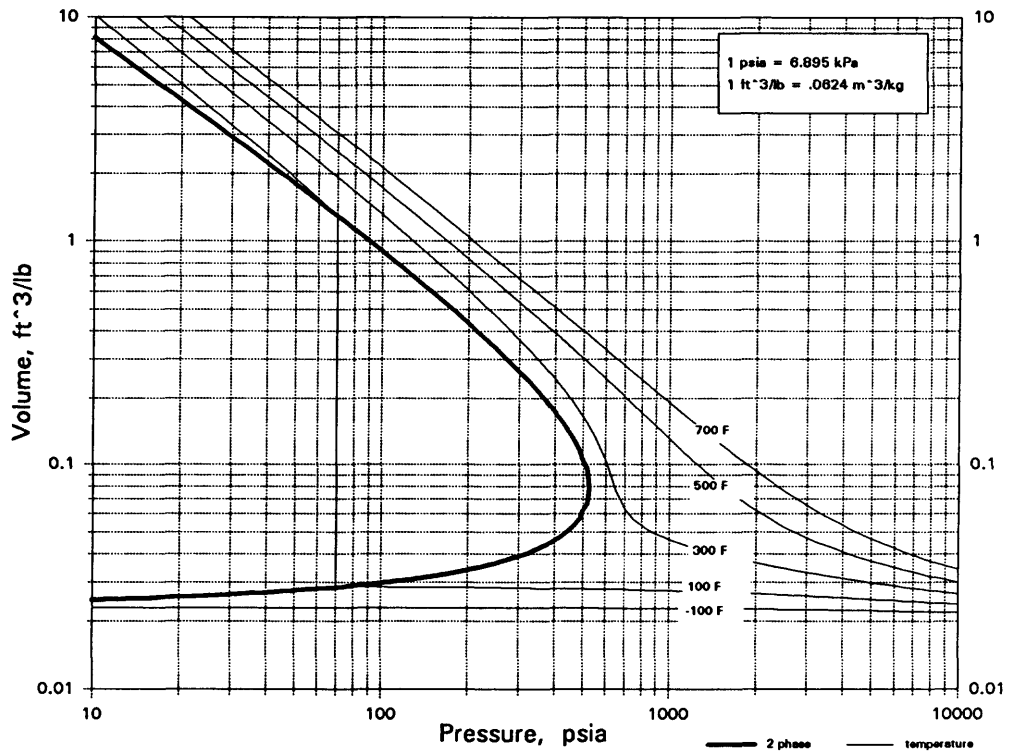
MORPHOLINE



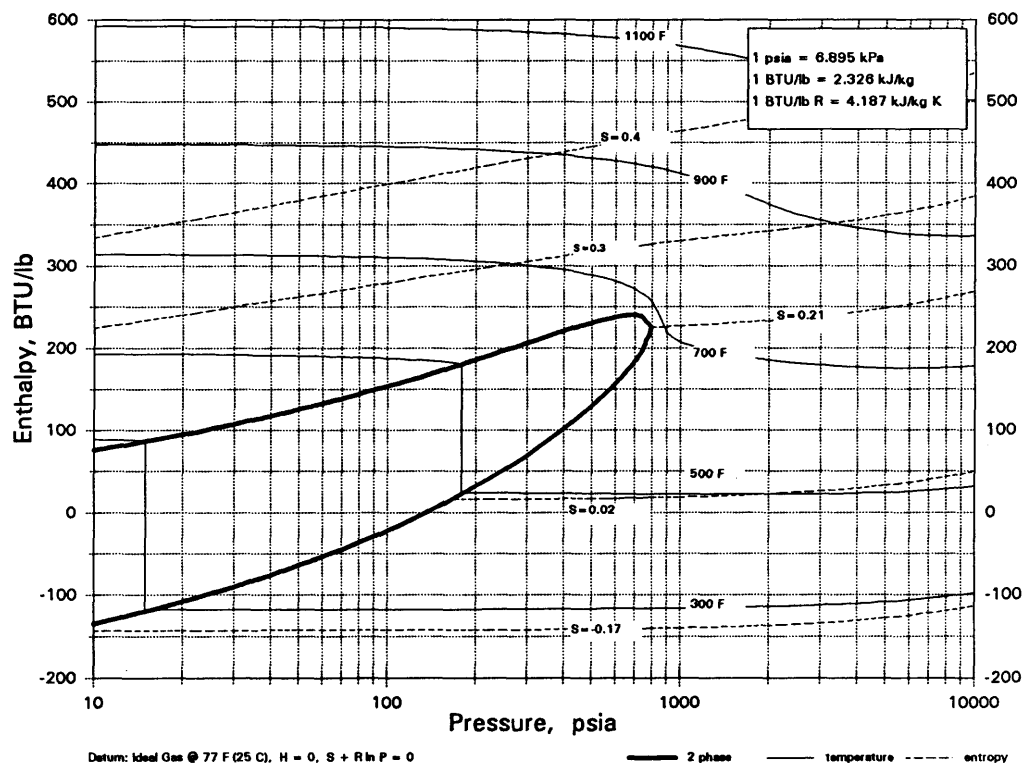
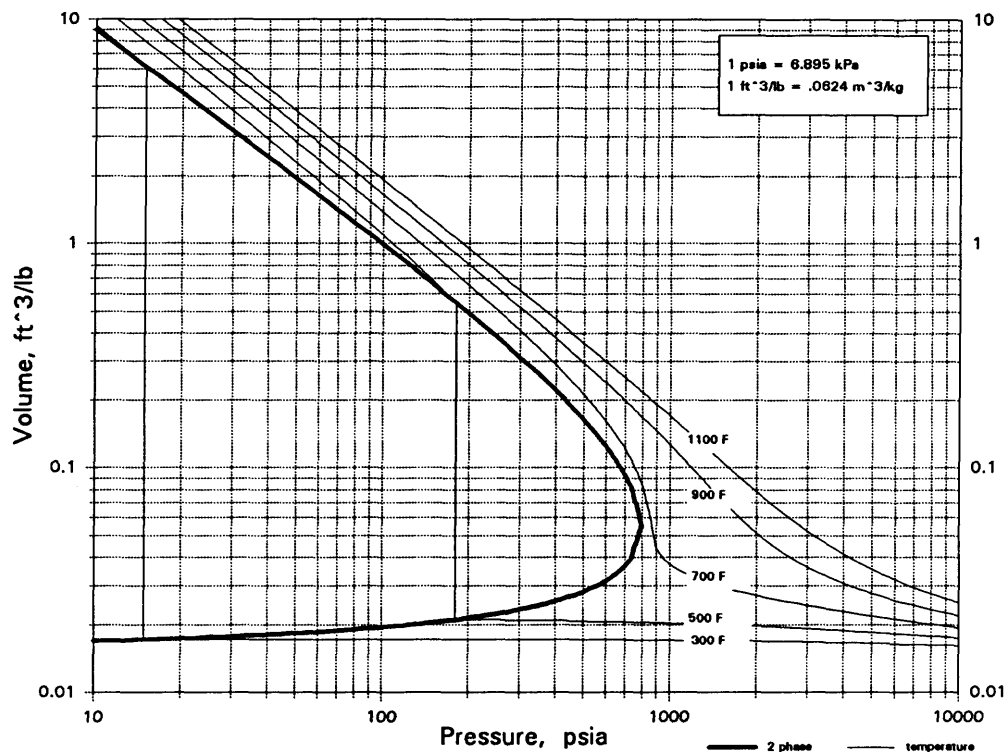
C4H10
n-BUTANE



C4H10
ISOBUTANE

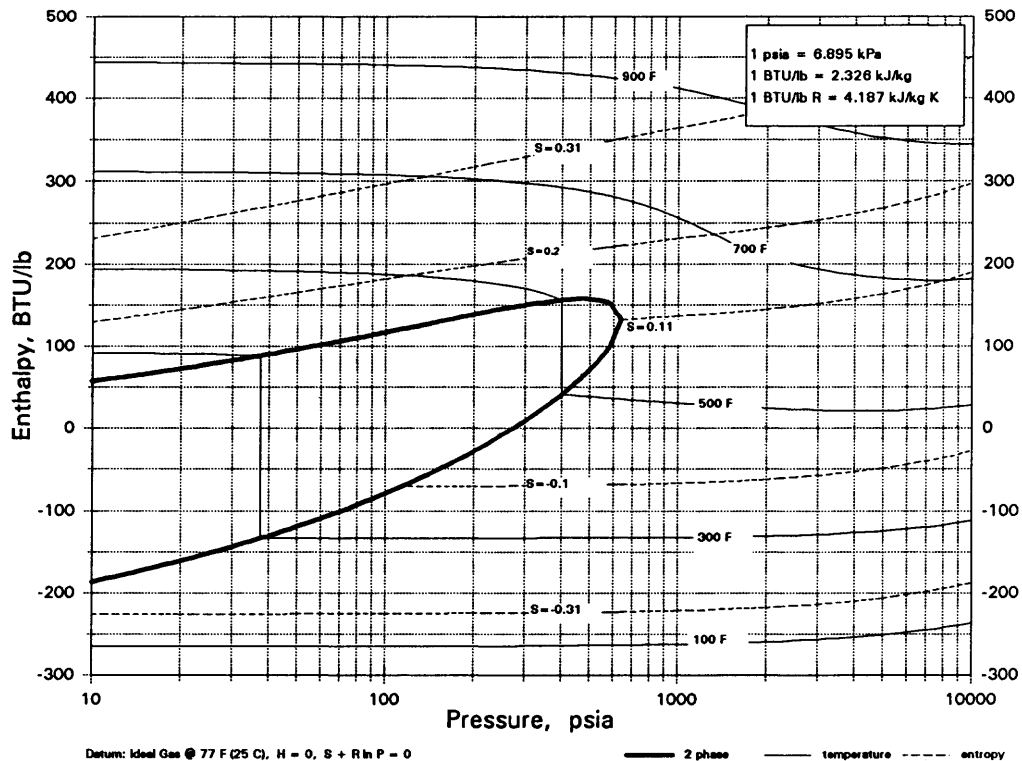
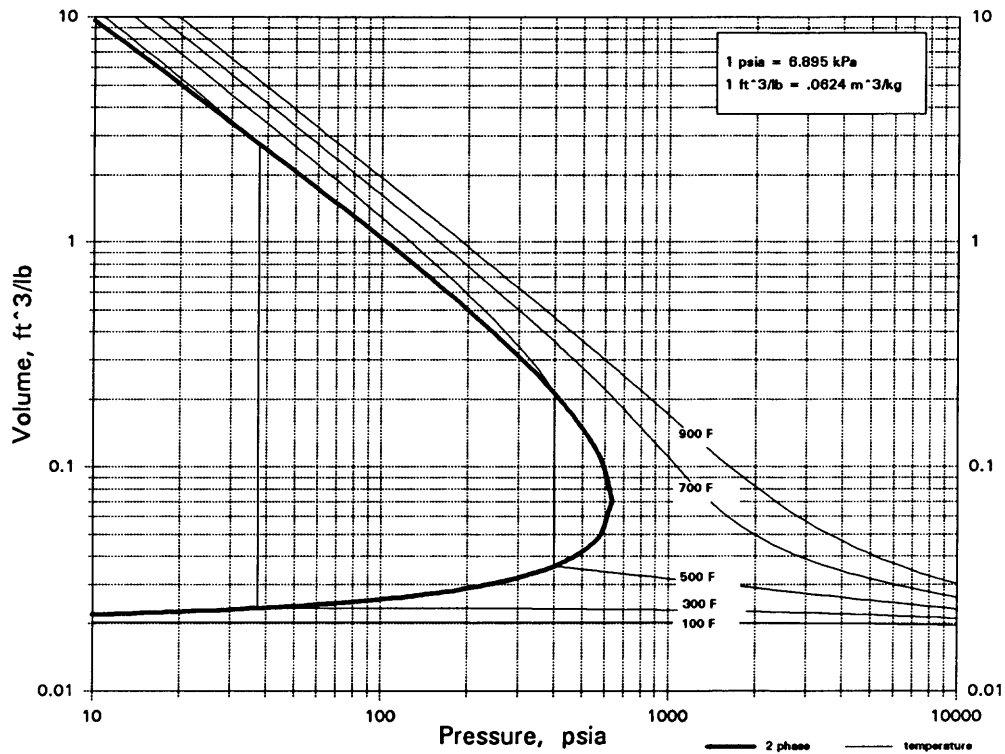


C4H10N2 PIPERAZINE

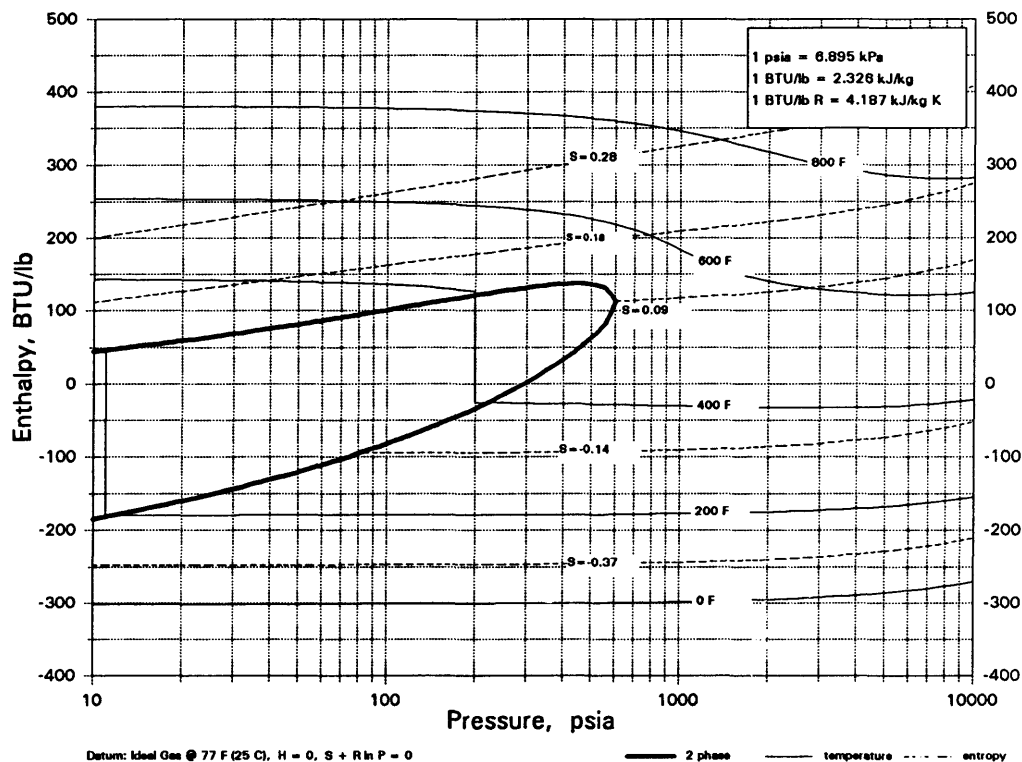
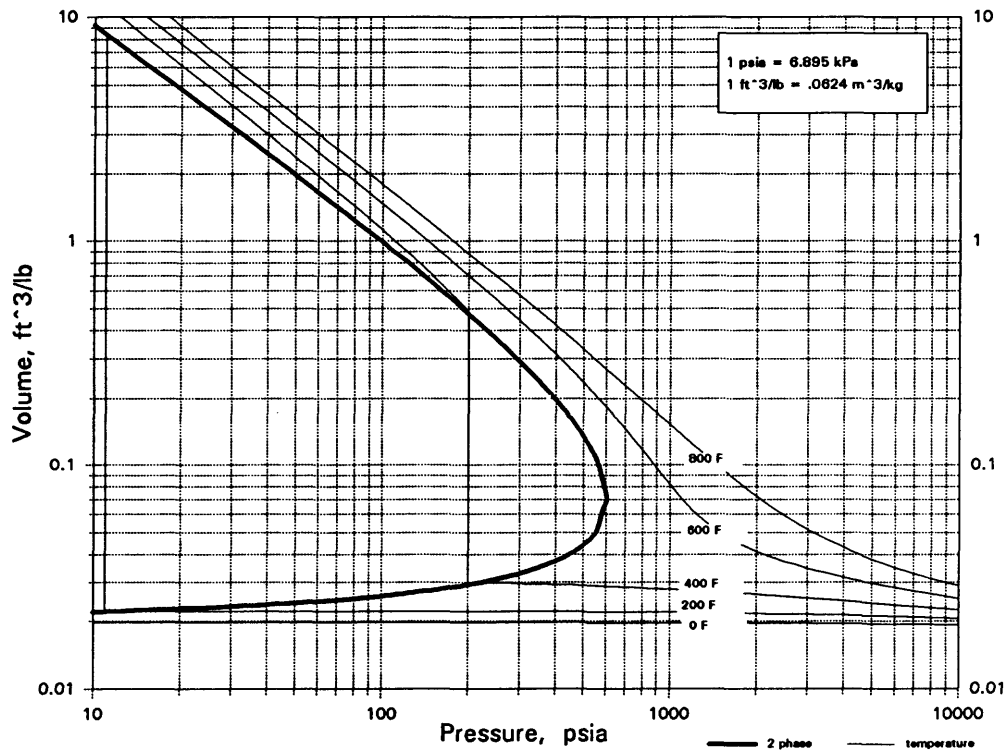


C4H10O

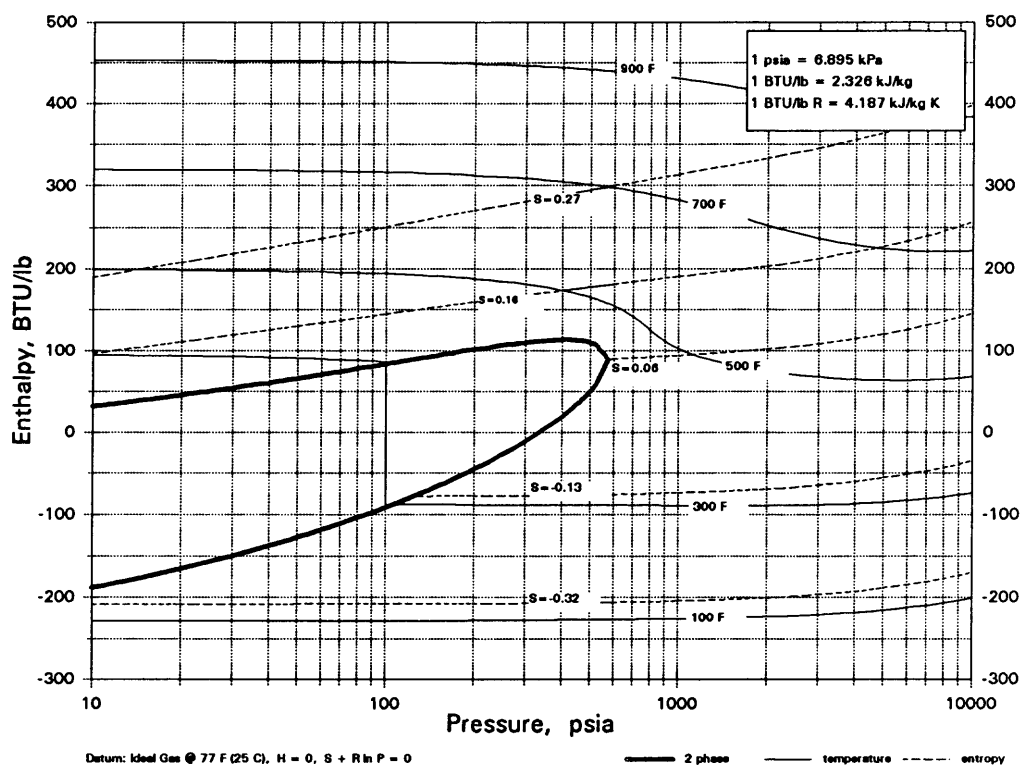
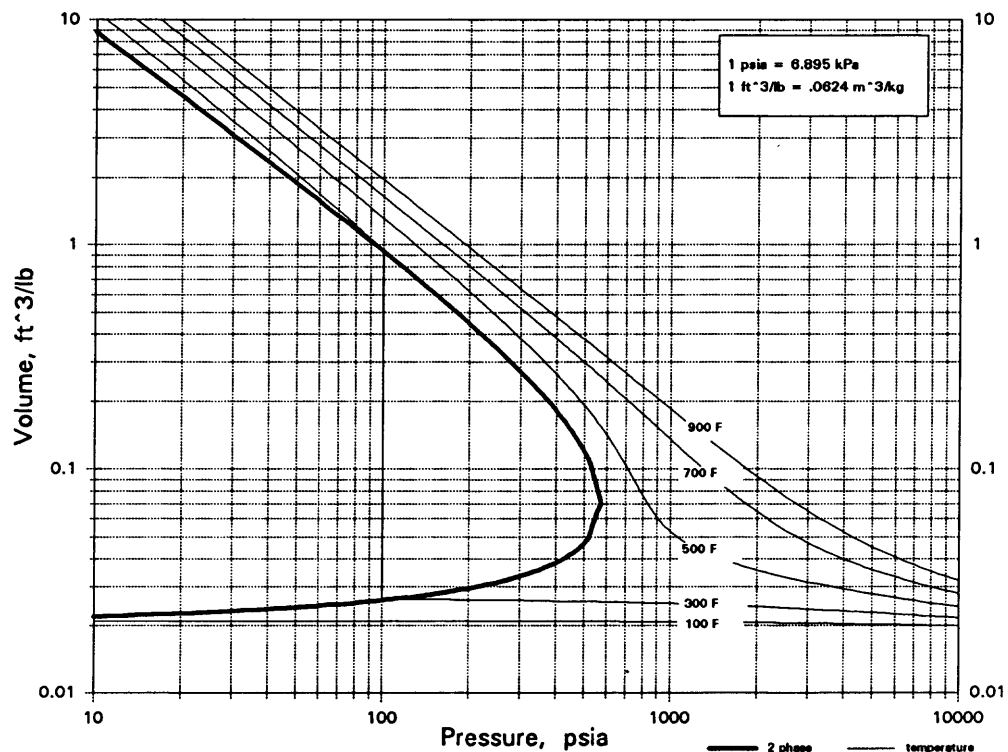
n-BUTANOL



C4H10O
sec-BUTANOL

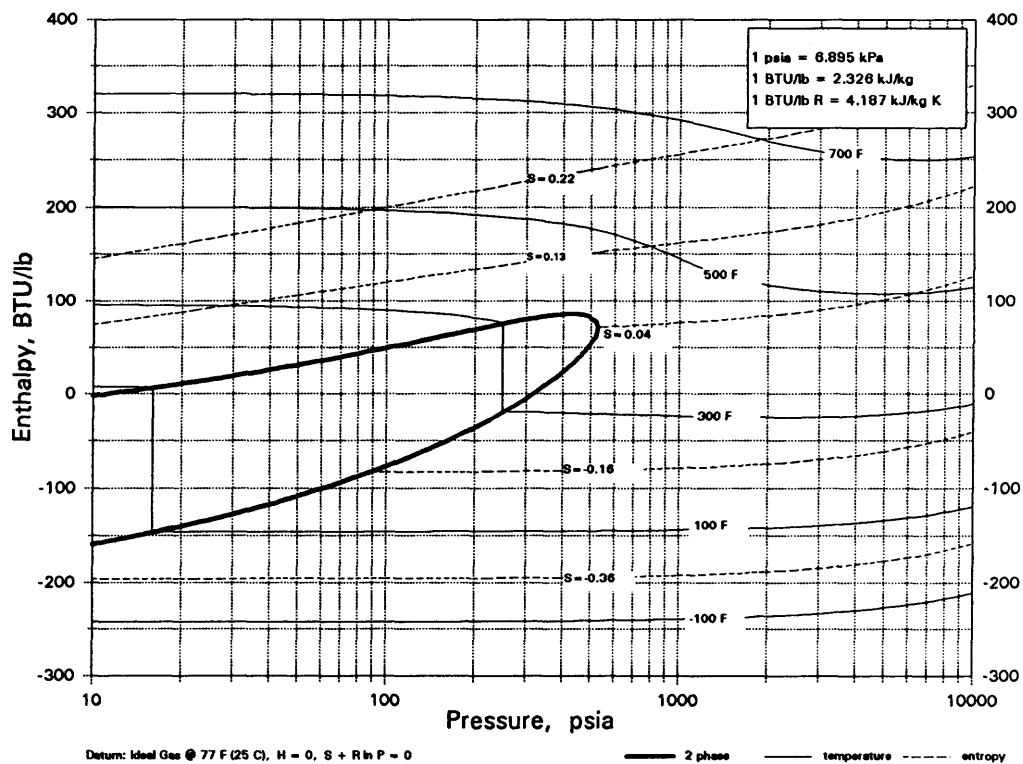
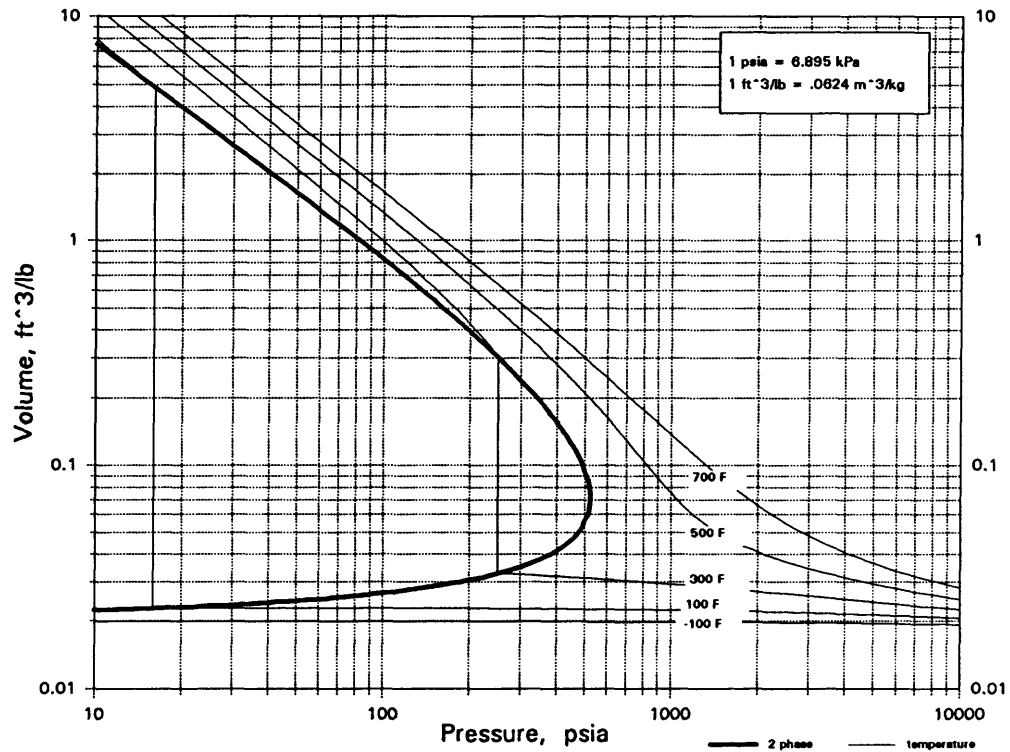


C4H10O tert-BUTANOL

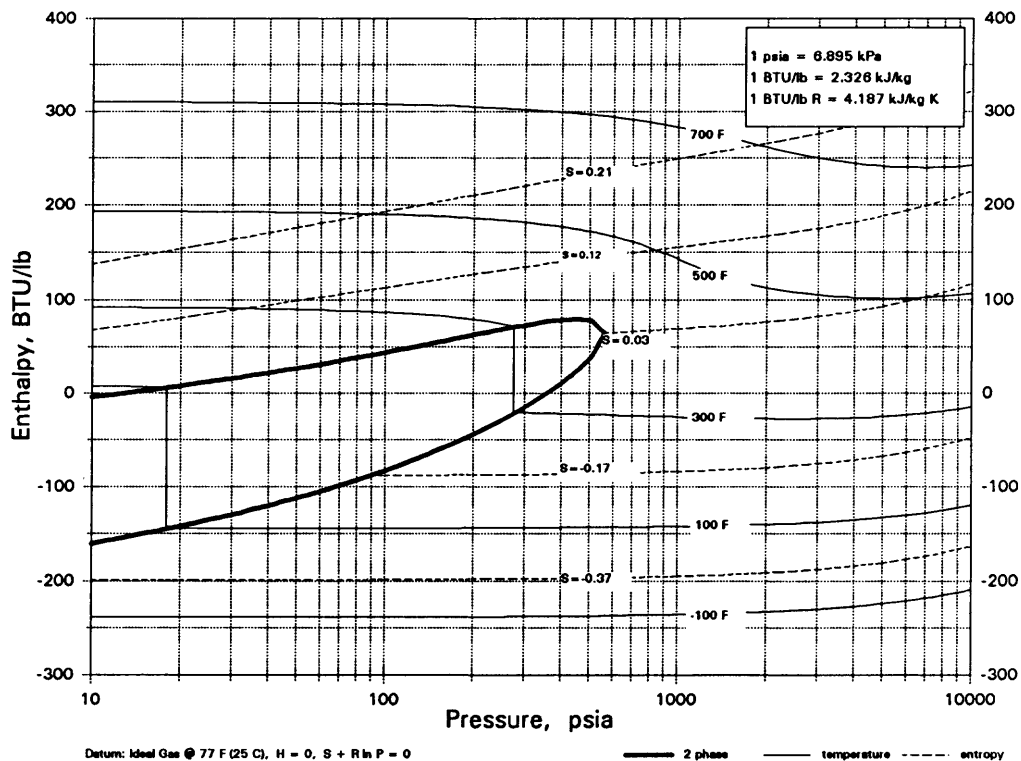
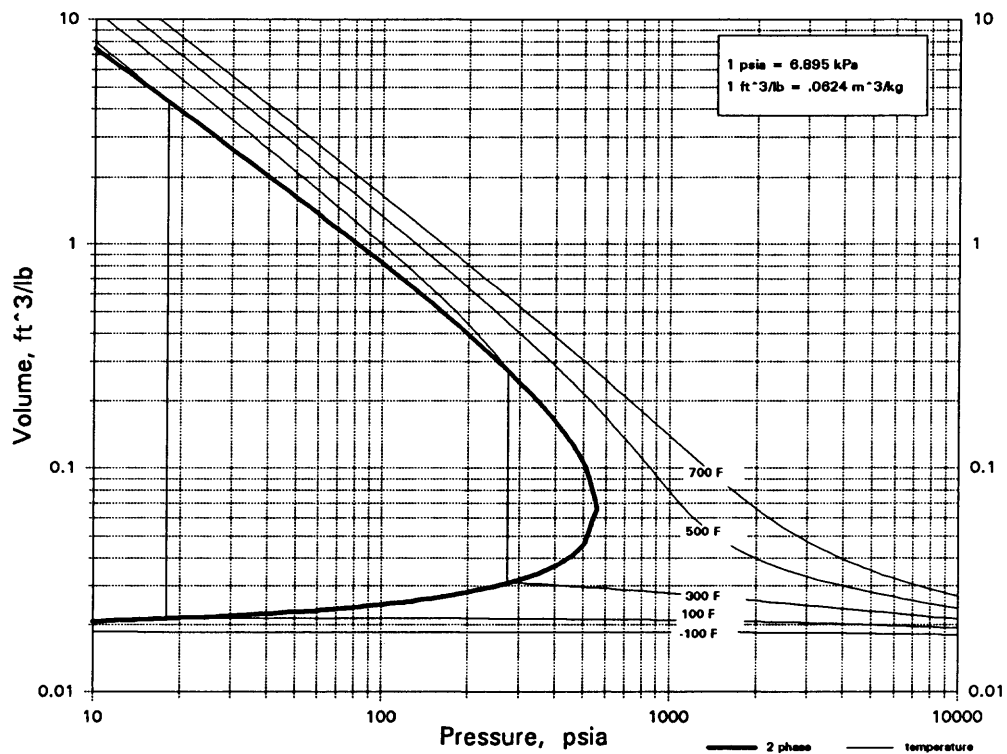


C4H10O

DIETHYL ETHER

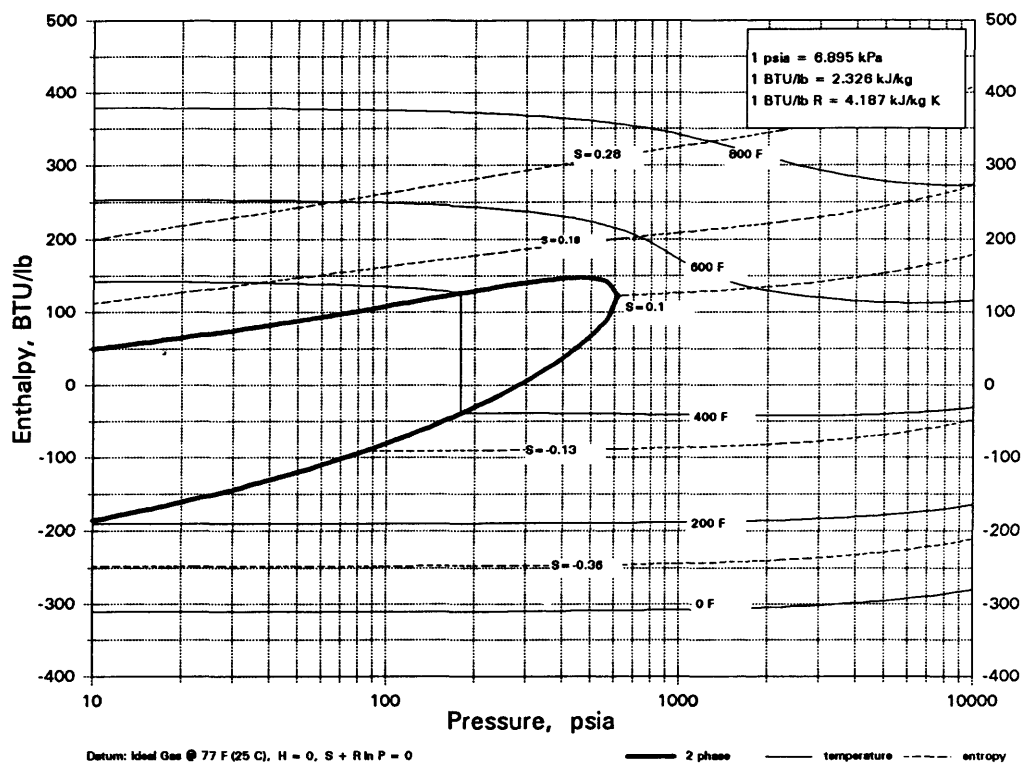
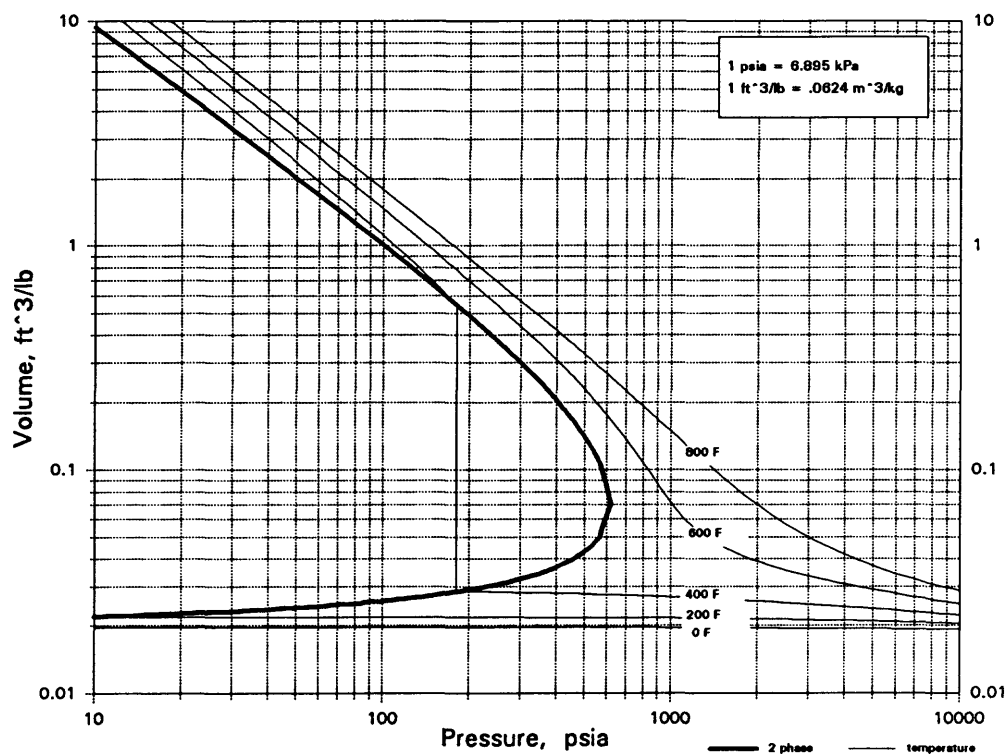


C4H10O
METHYL ISOPROPYL ETHER



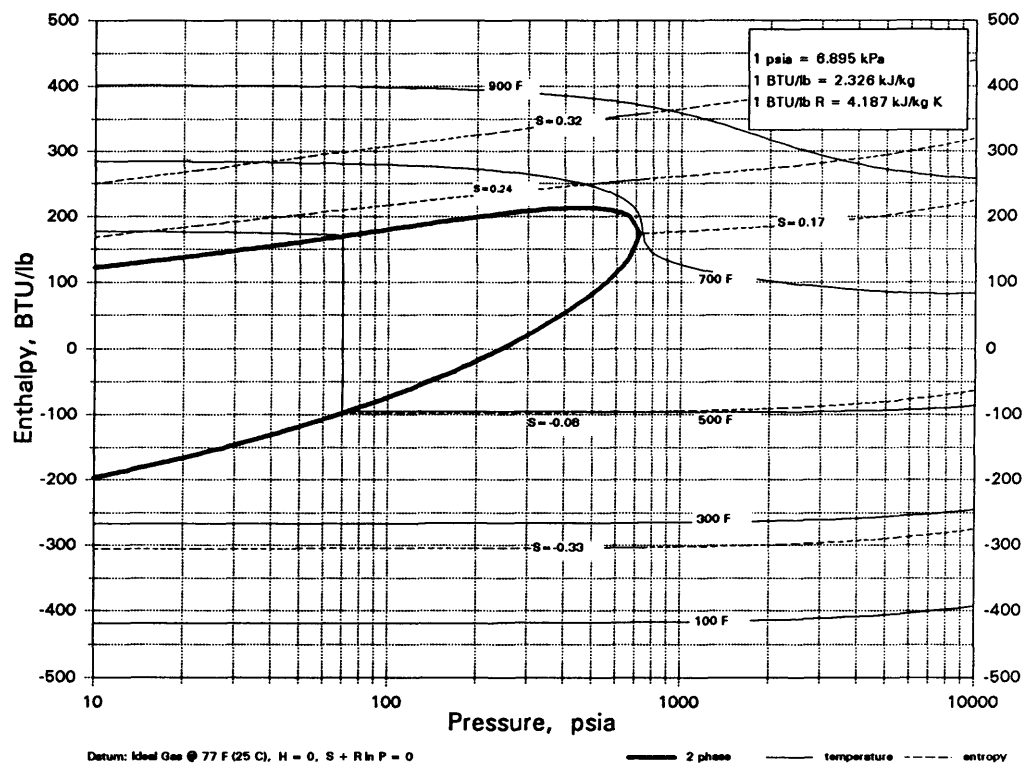
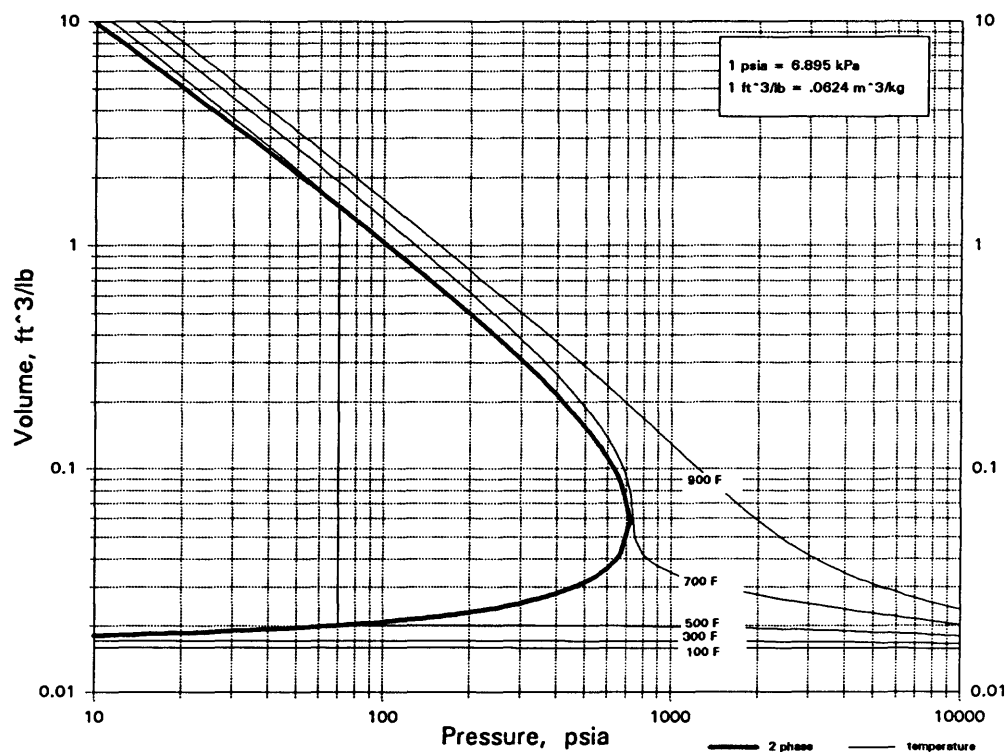
C4H10O

ISOBUTANOL

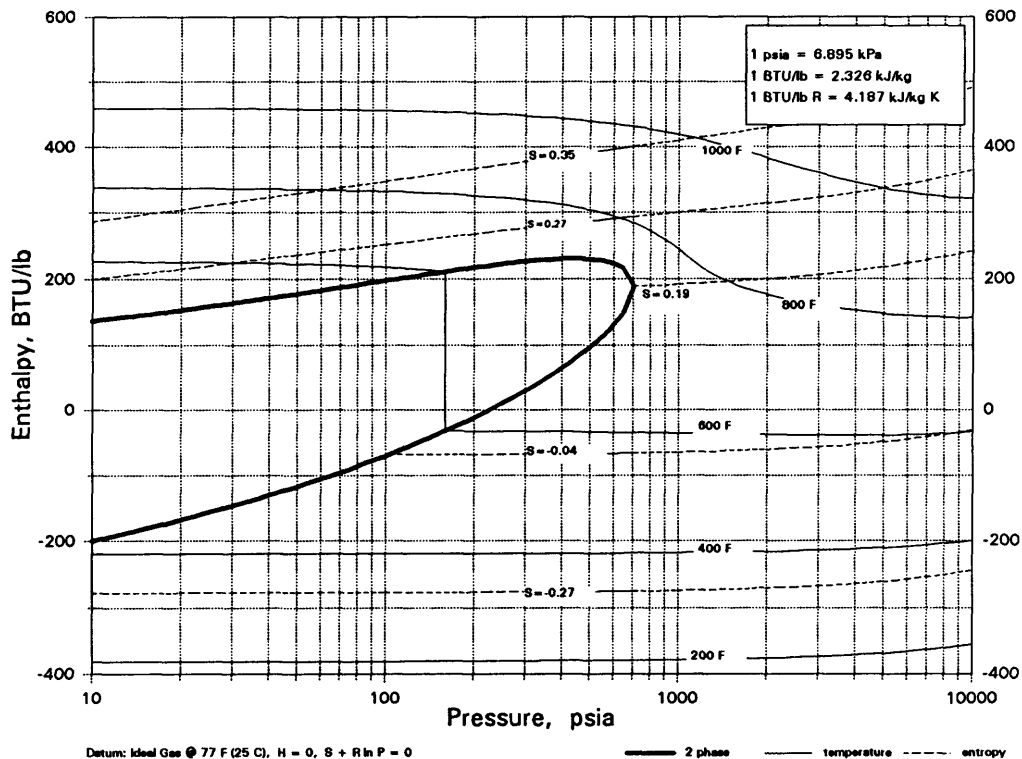
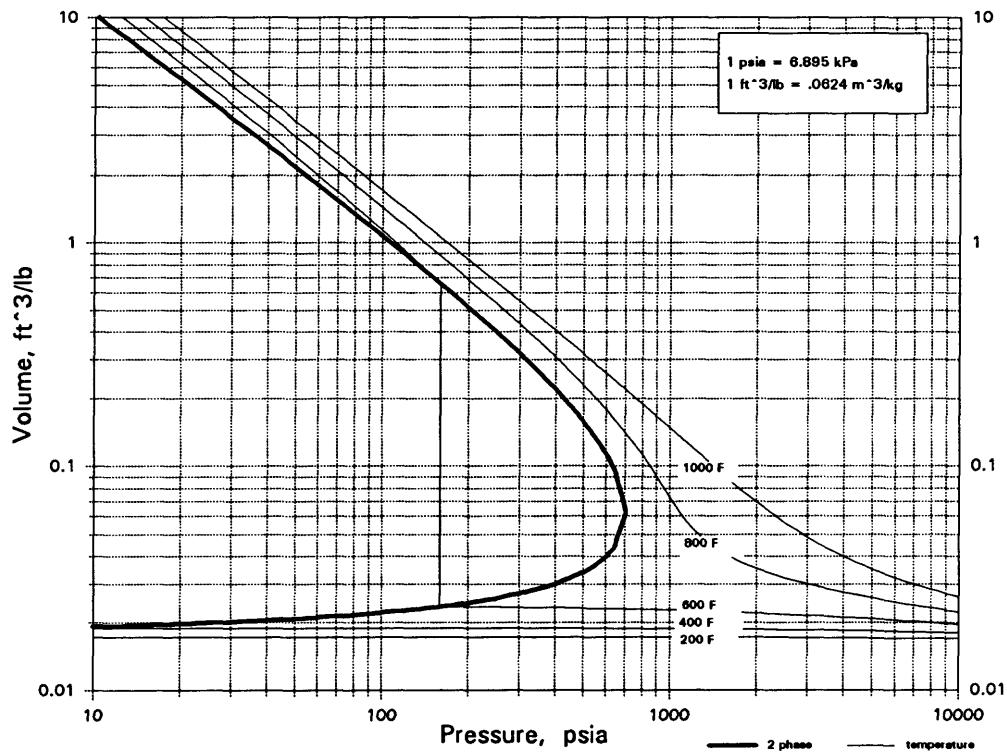


C4H10O2

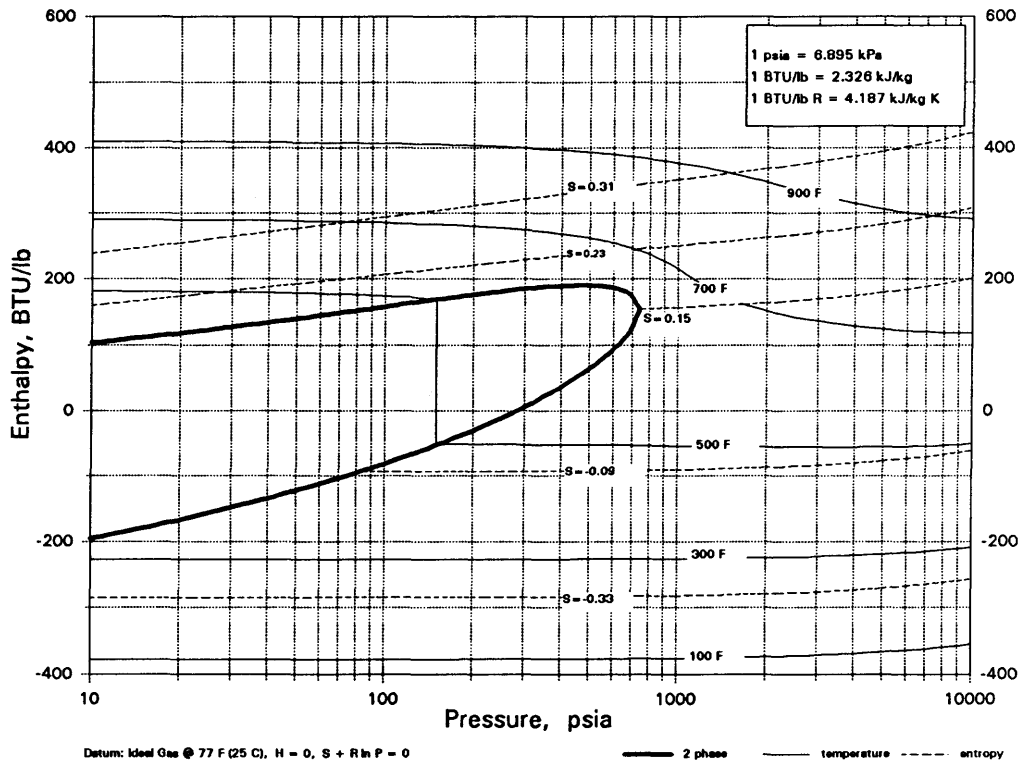
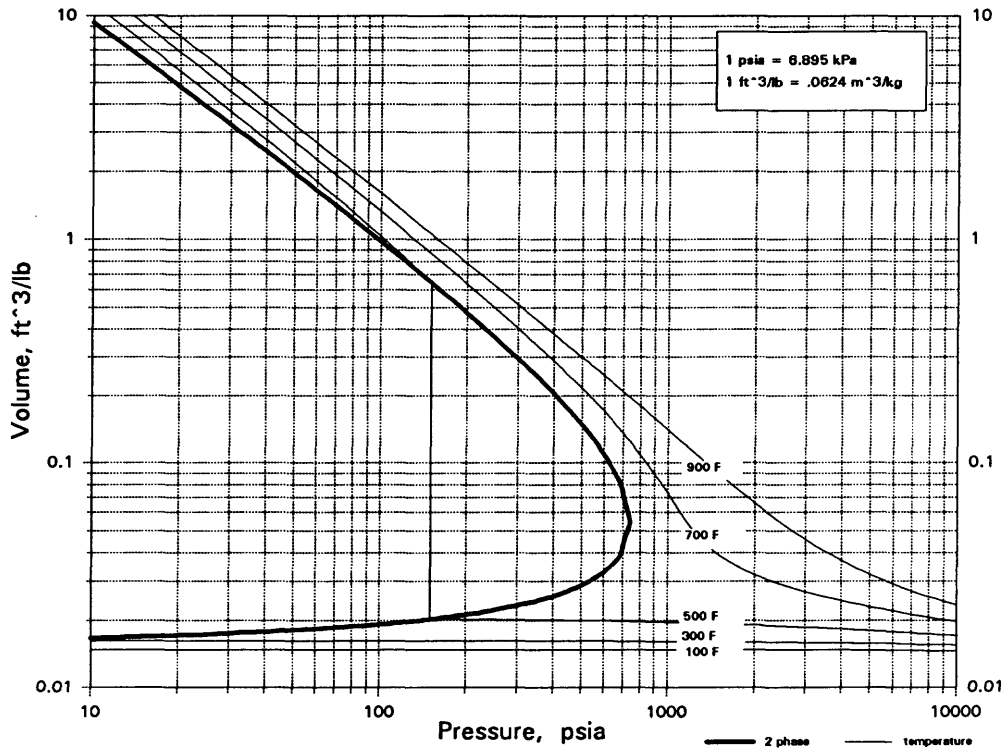
1-3-BUTANEDIOL



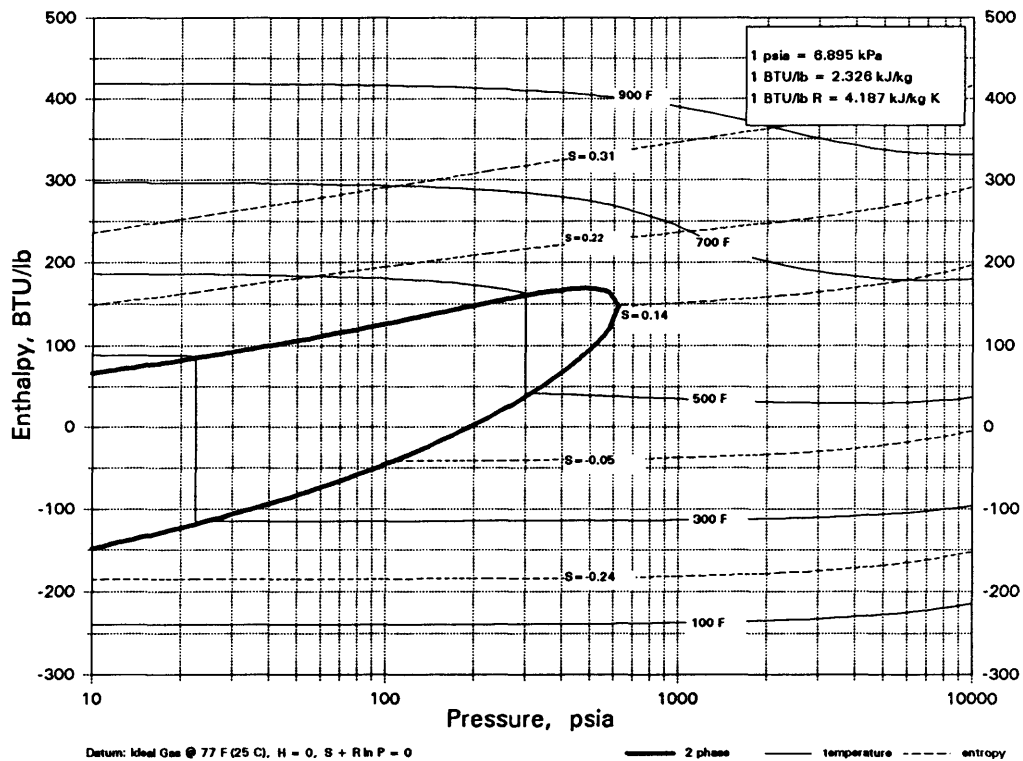
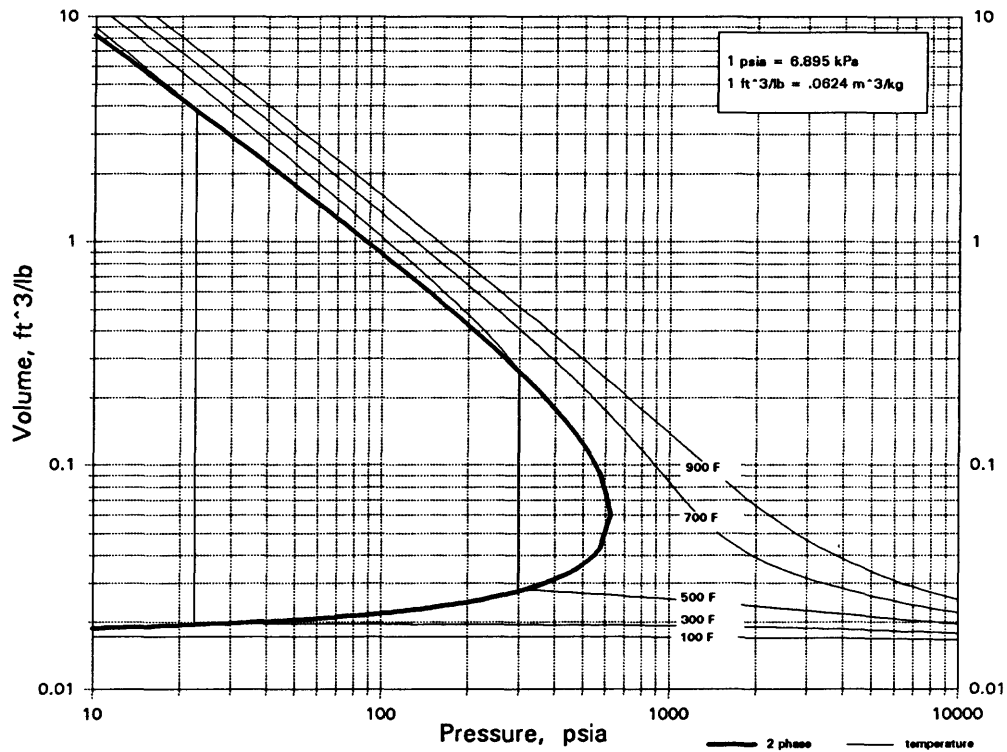
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1-4-BUTANEDIOL



C4H10O2
2-3-BUTANEDIOL

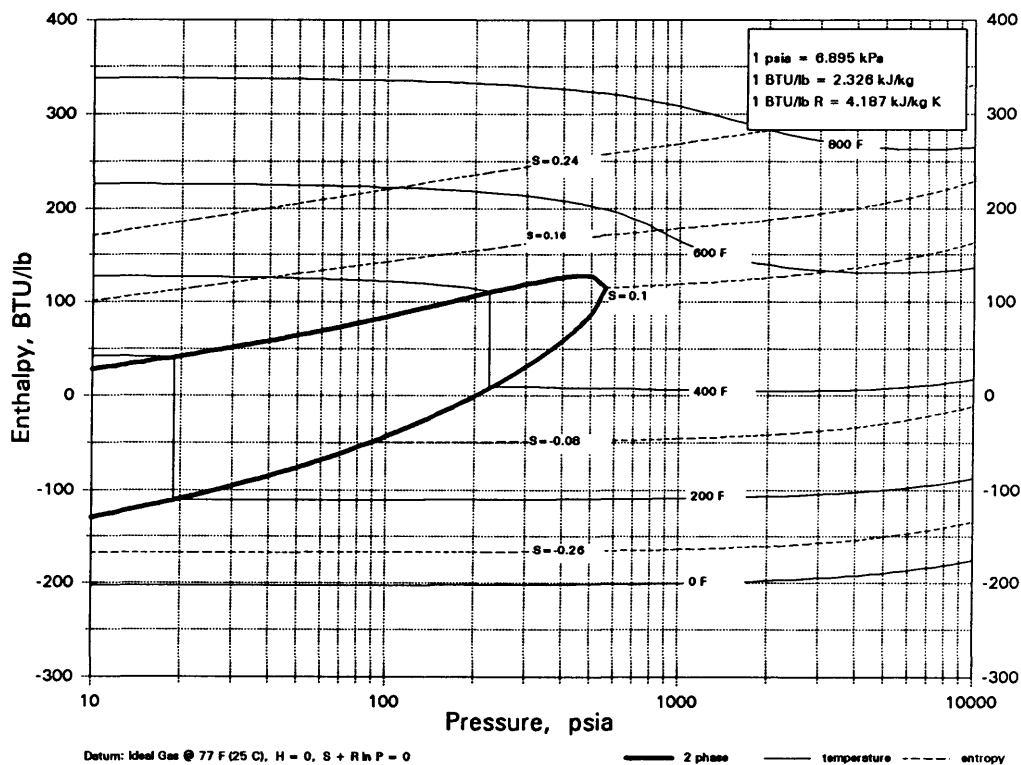
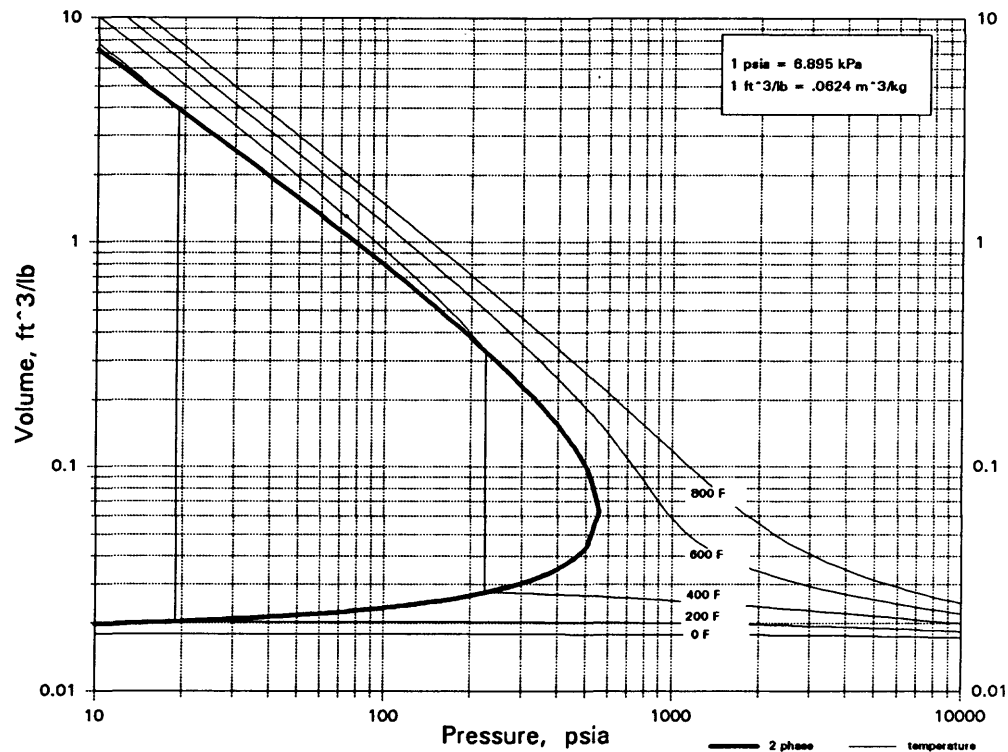


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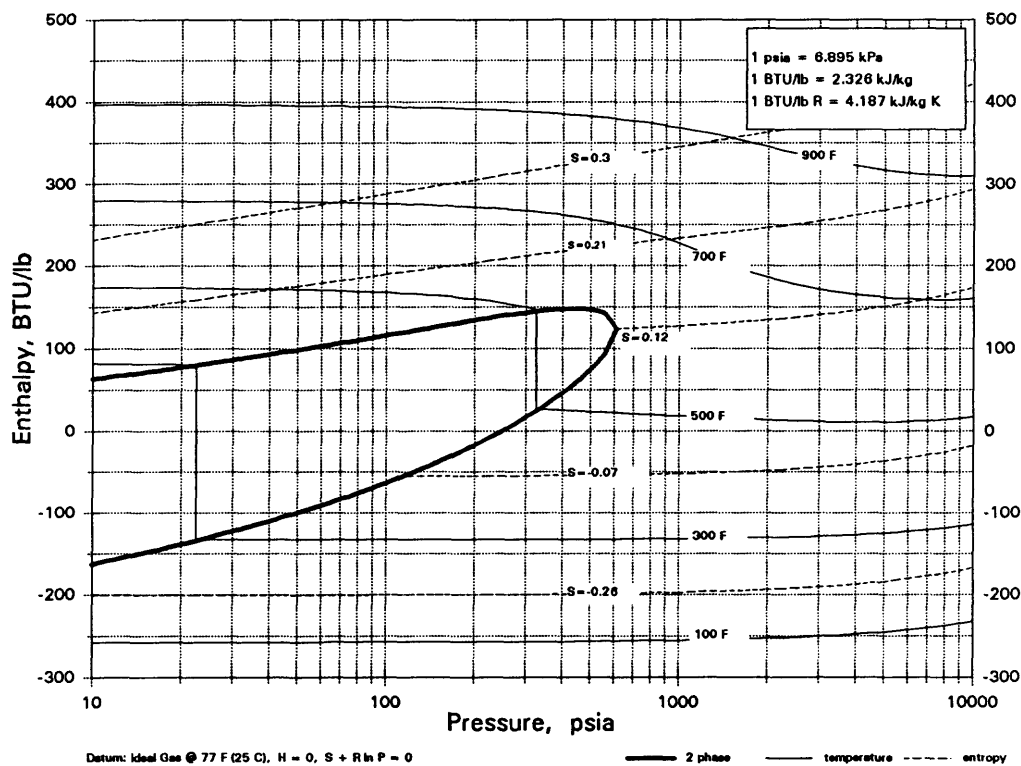
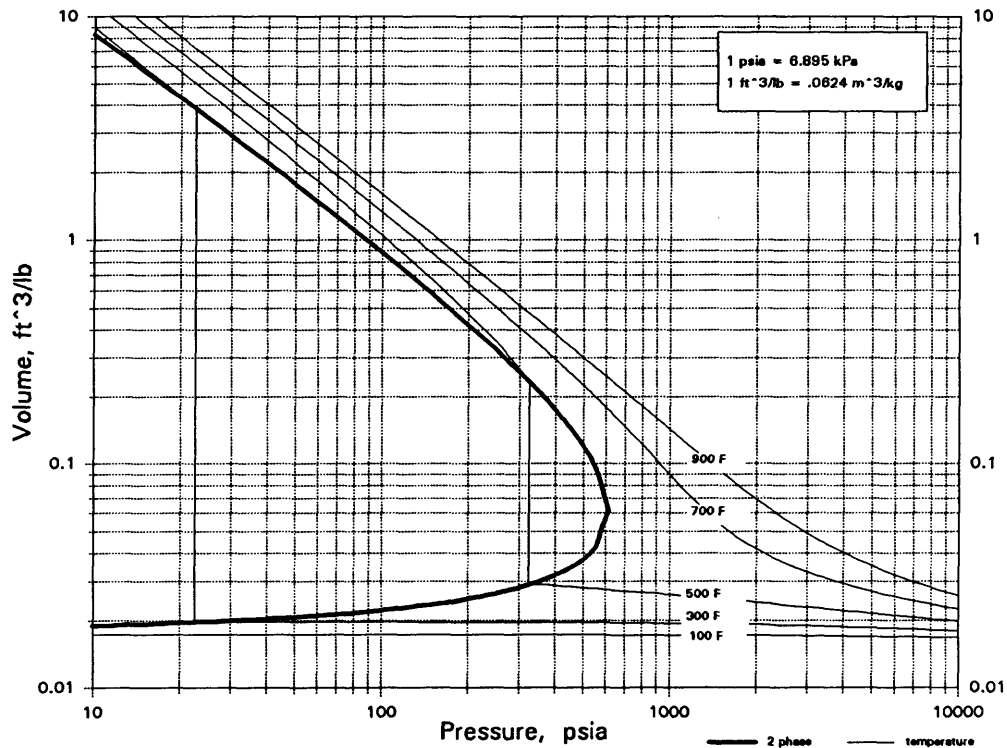
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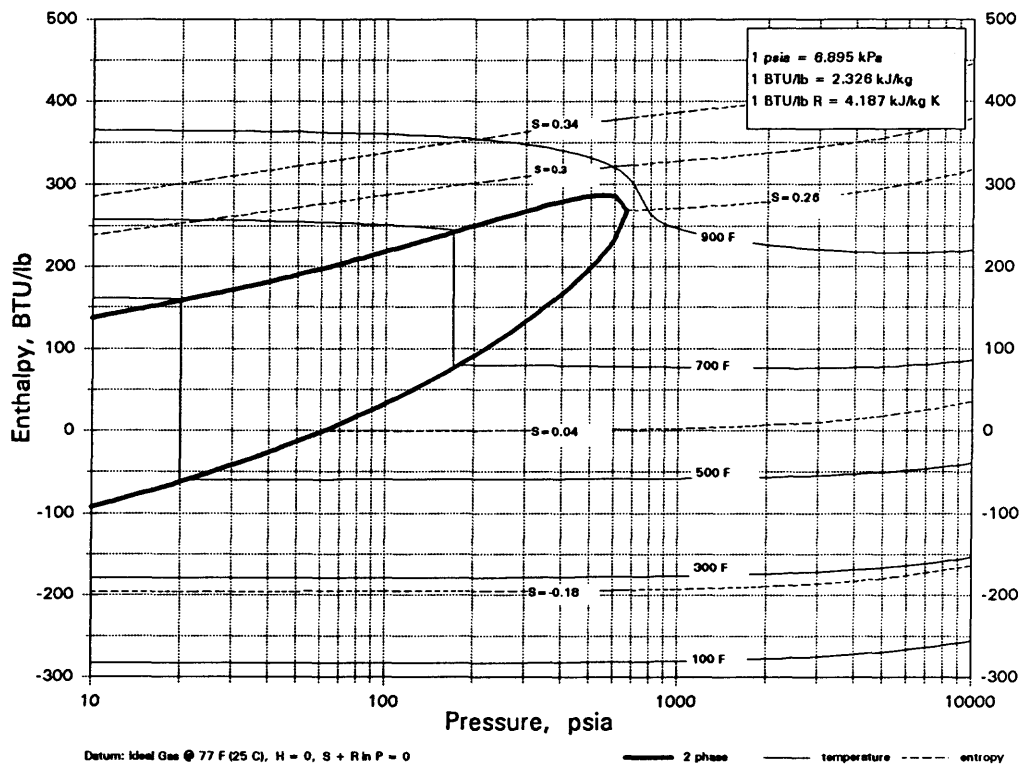
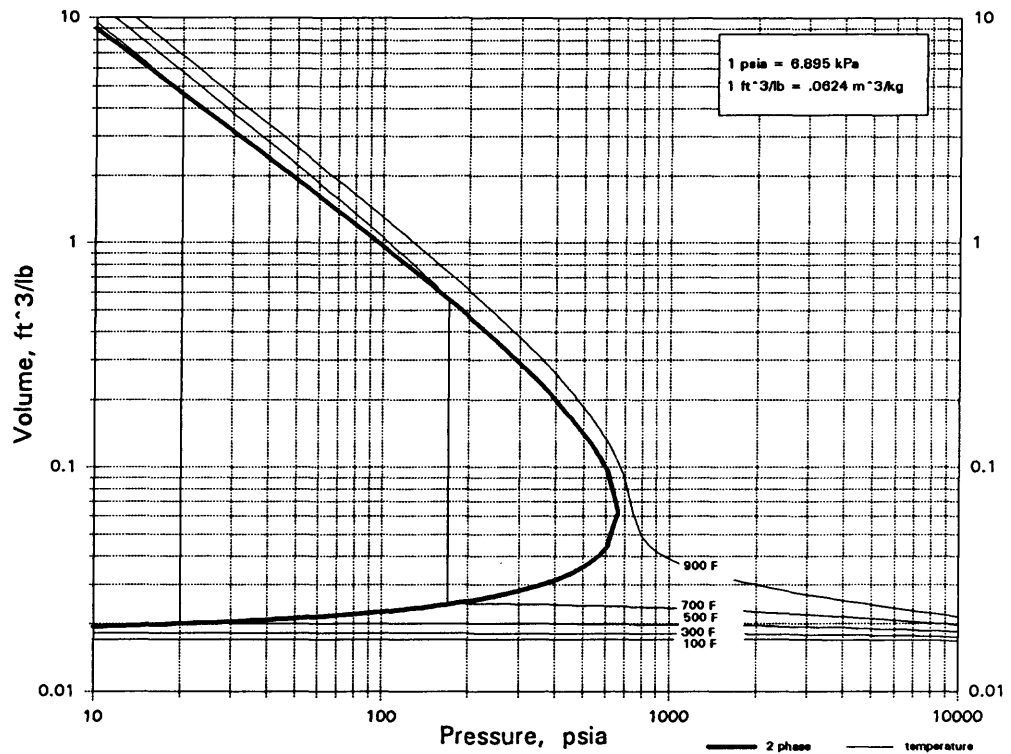


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2-ETHOXYETHANOL

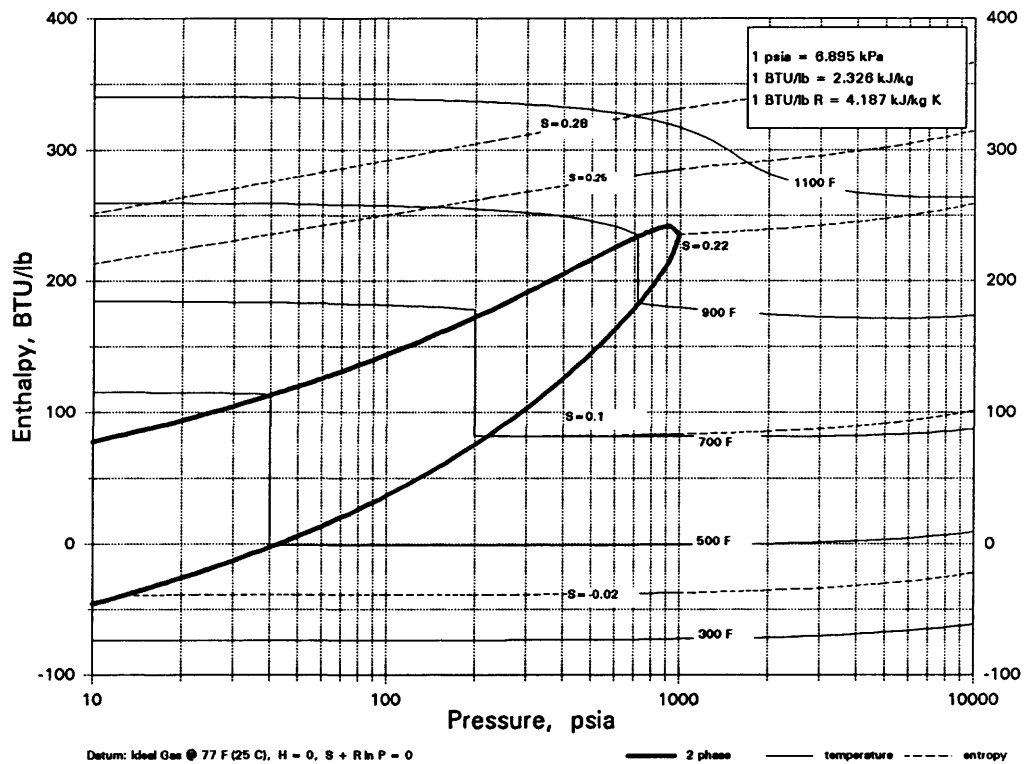
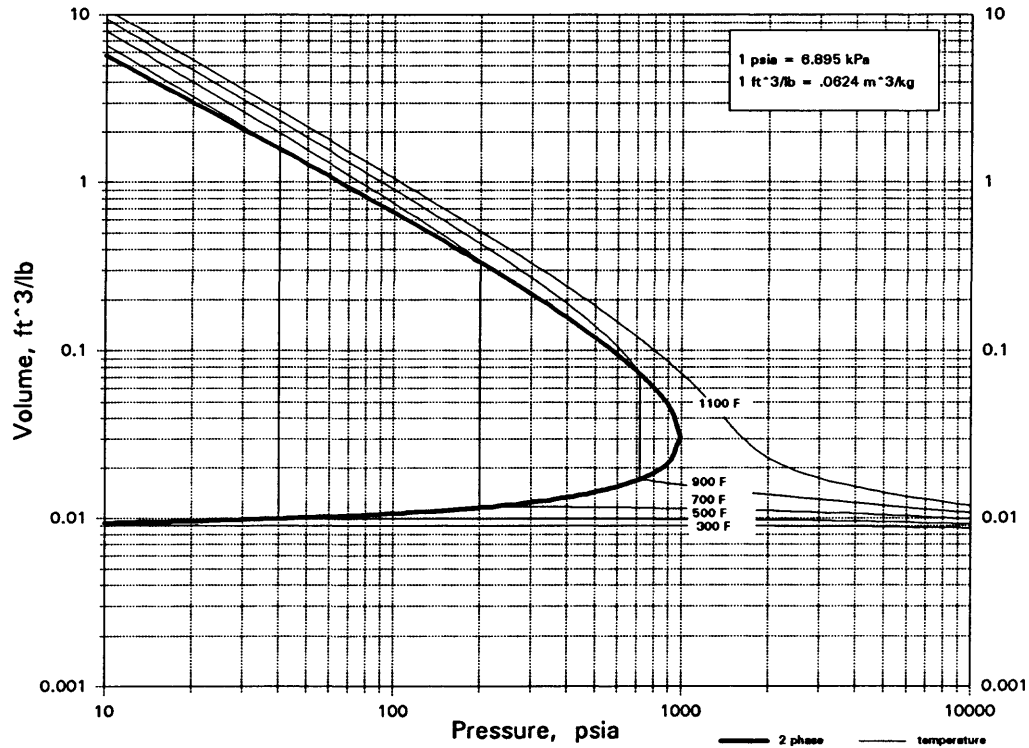


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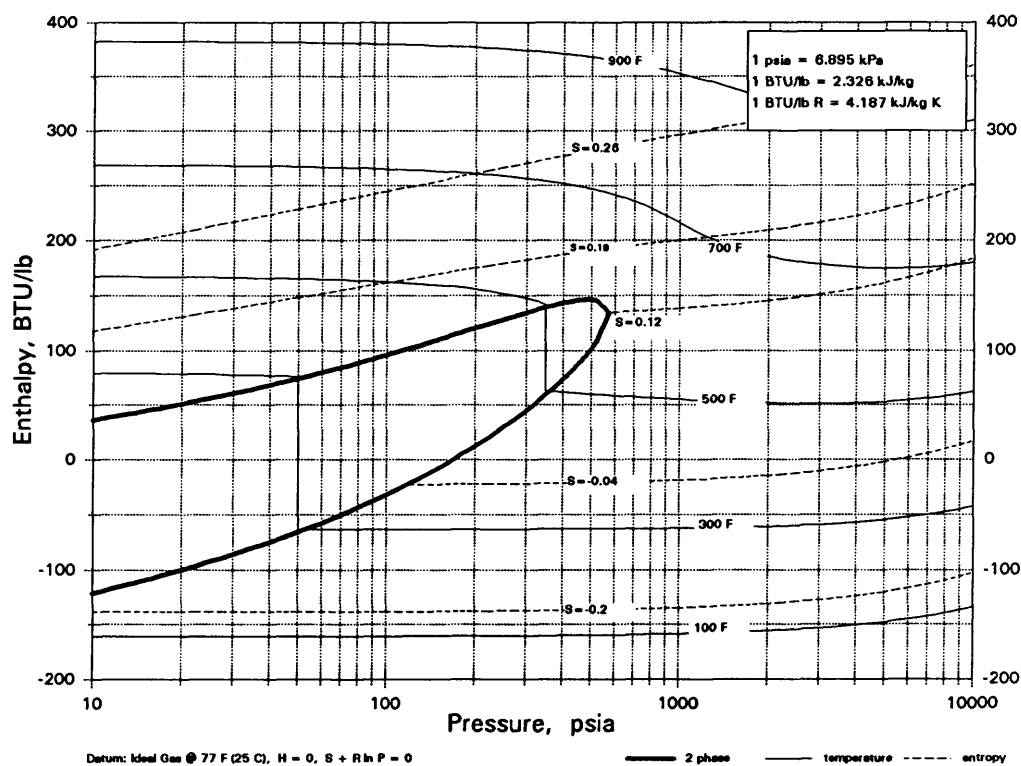
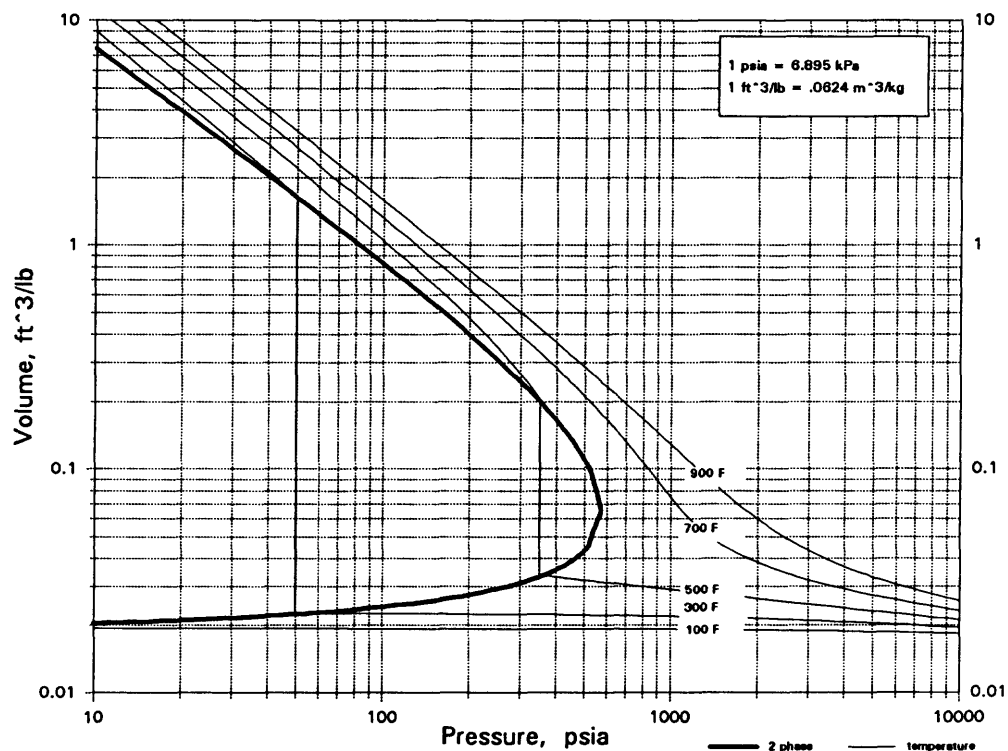
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DIETHYL SULFATE



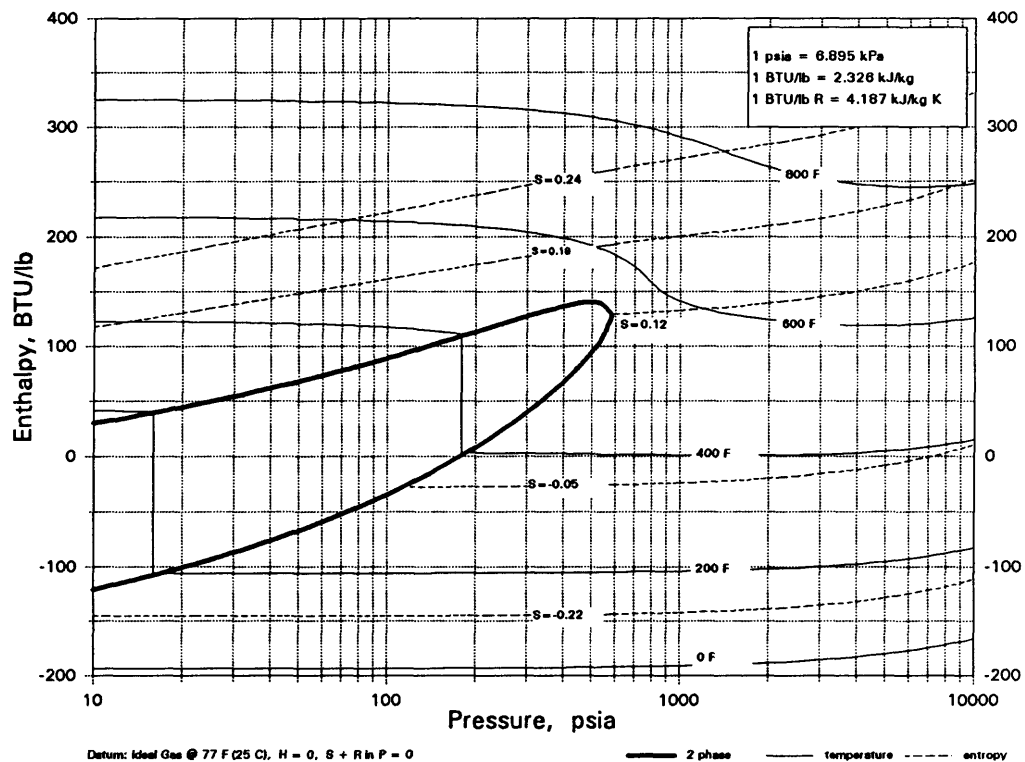
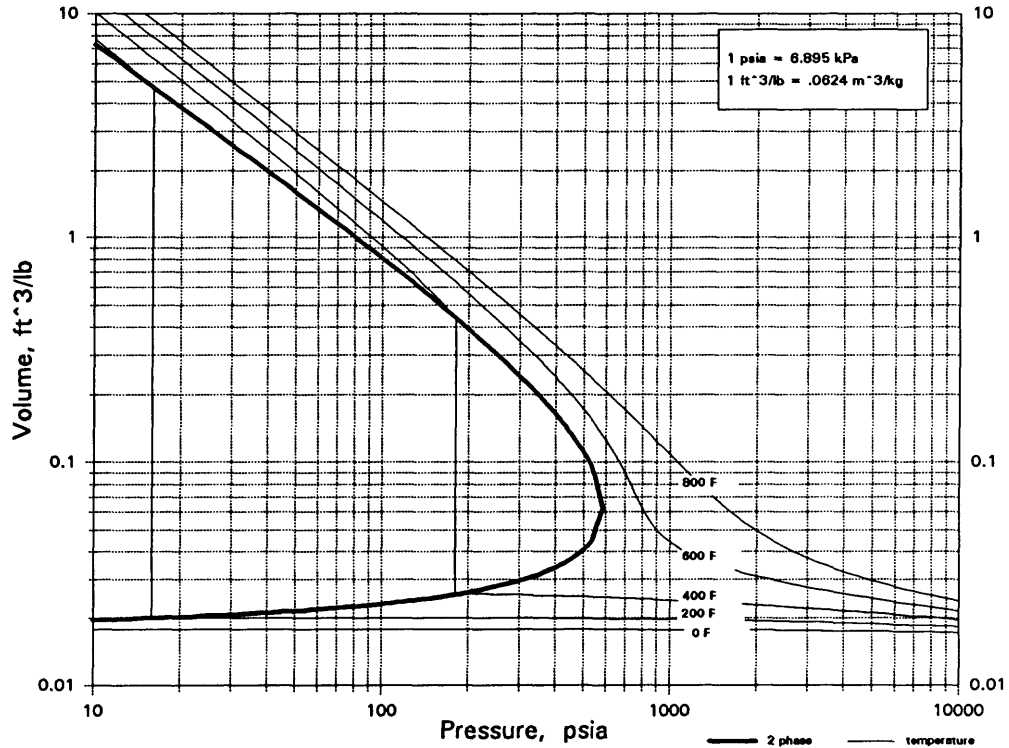
C4H10S

n-BUTYL MERCAPTAN



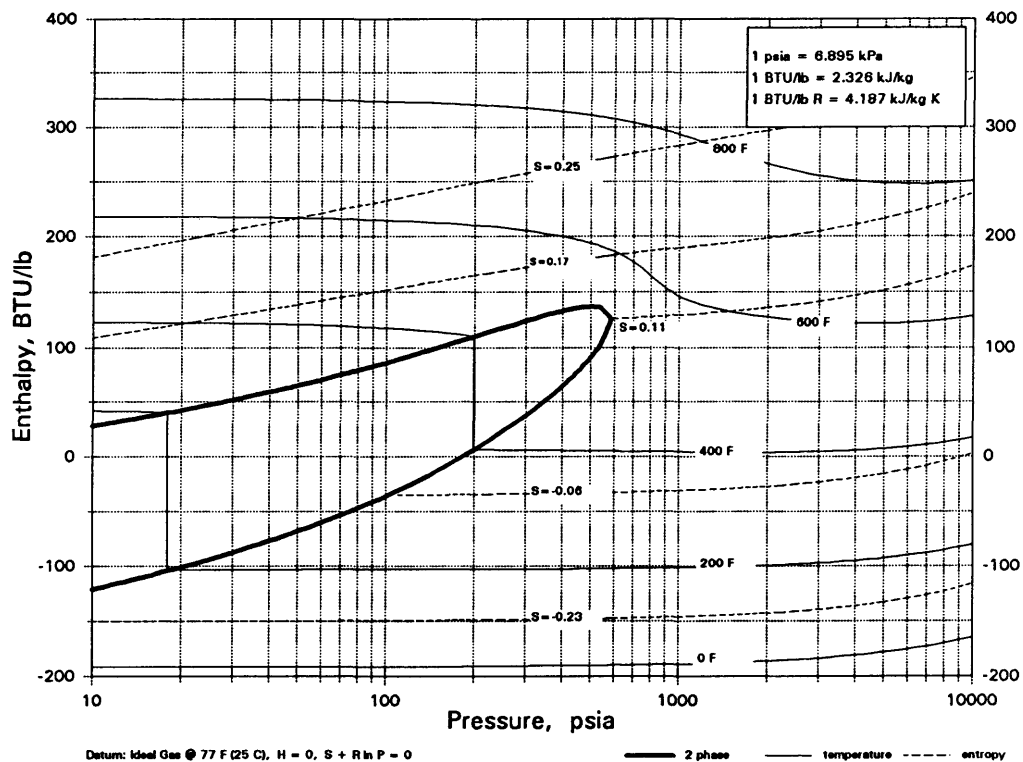
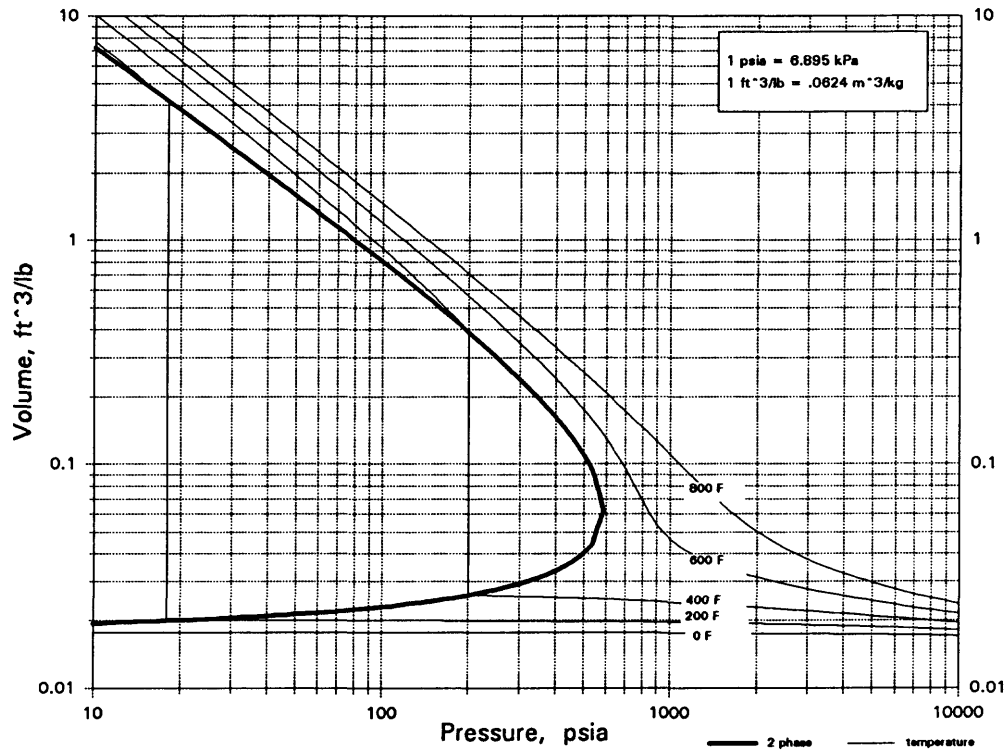
C4H10S

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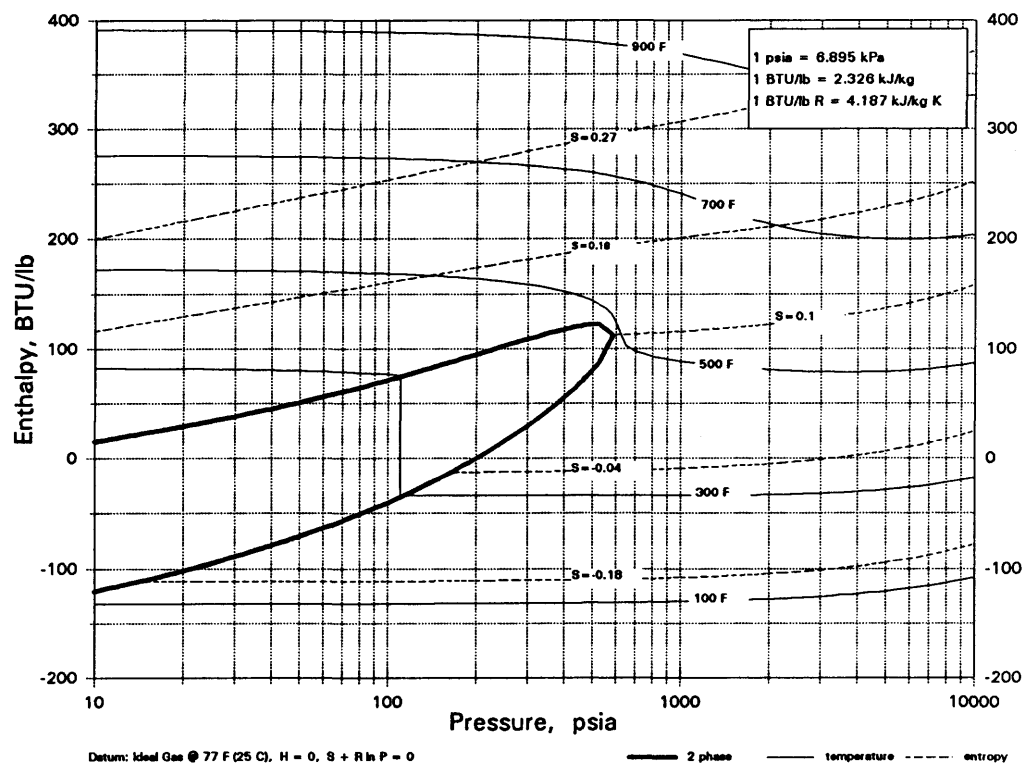
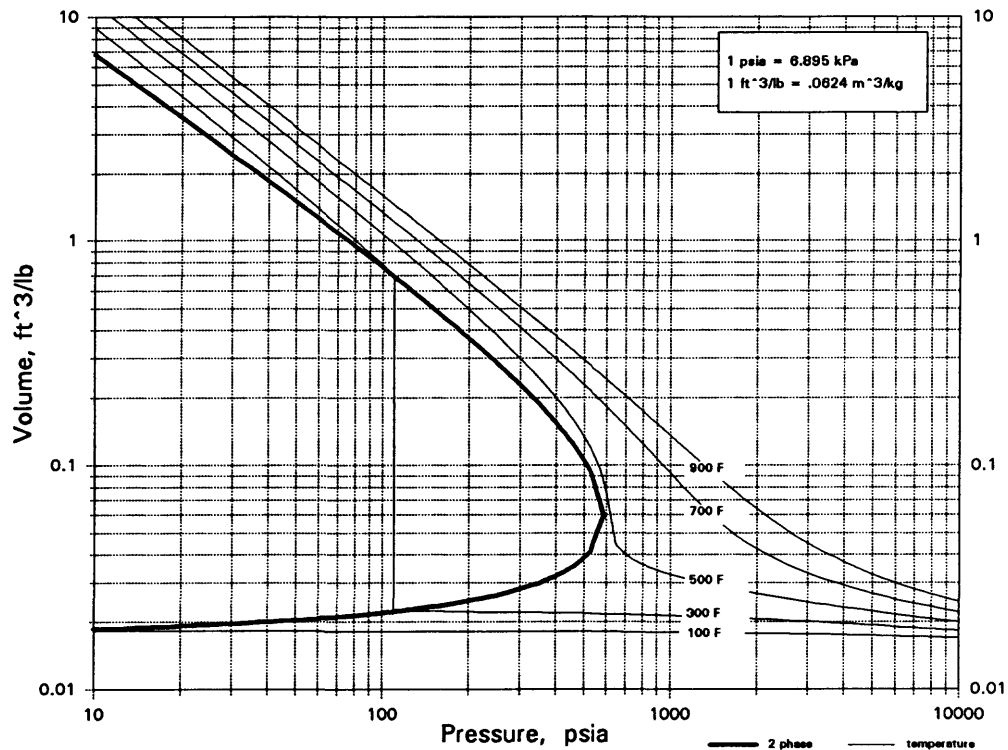
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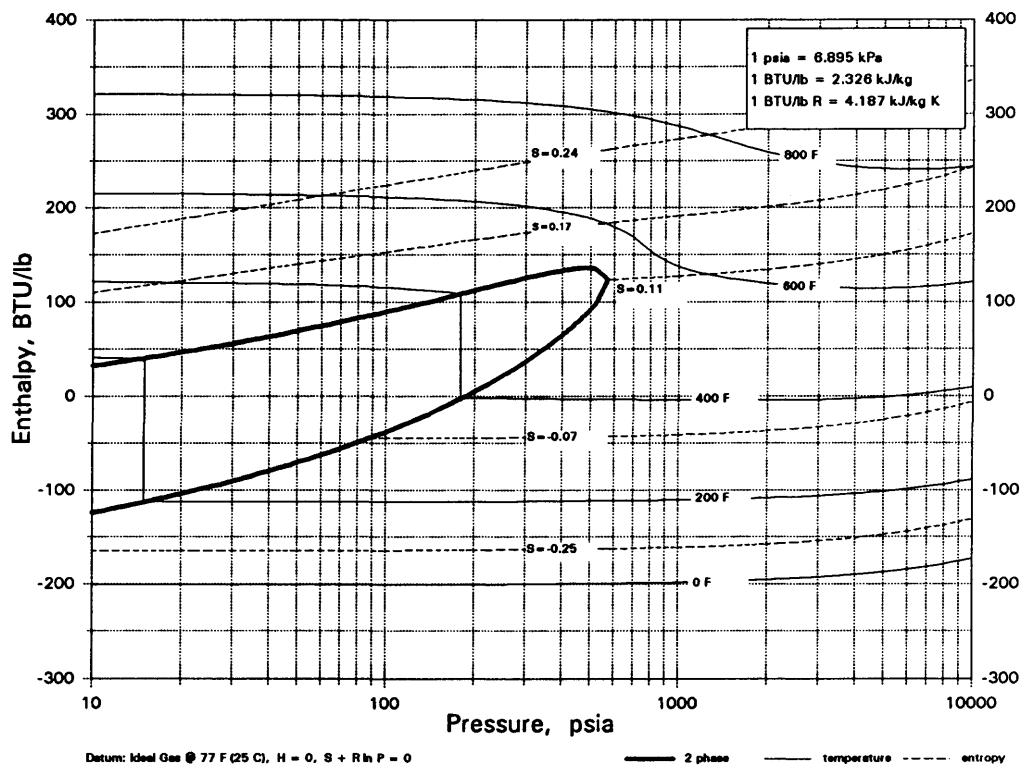
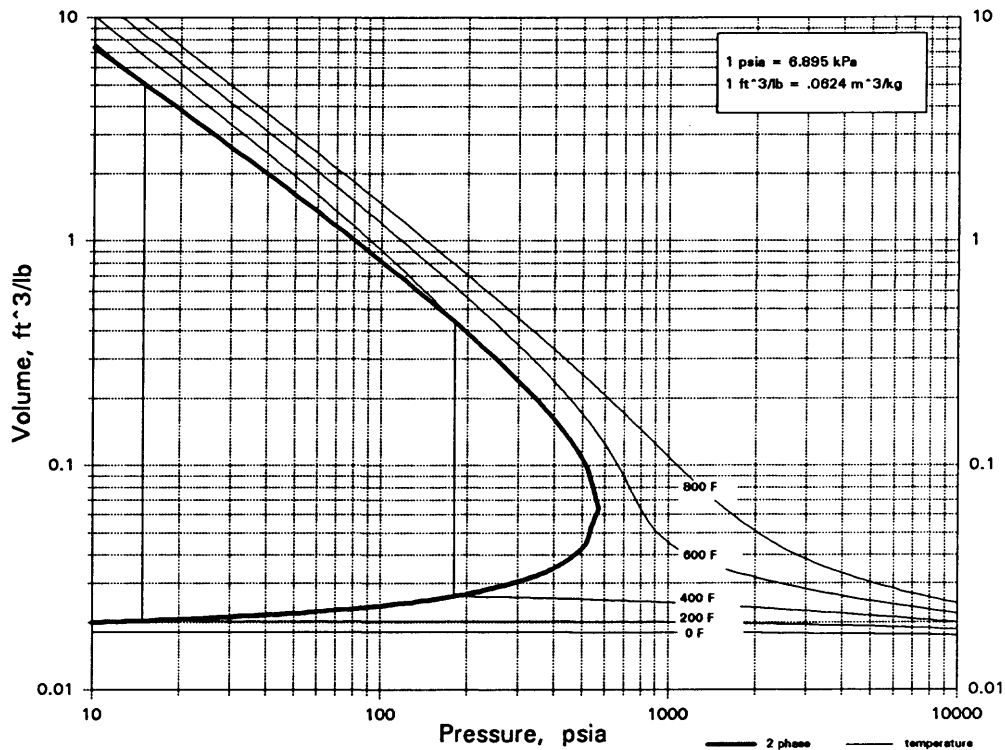


C4H10S

tert-BUTYL MERCAPTAN

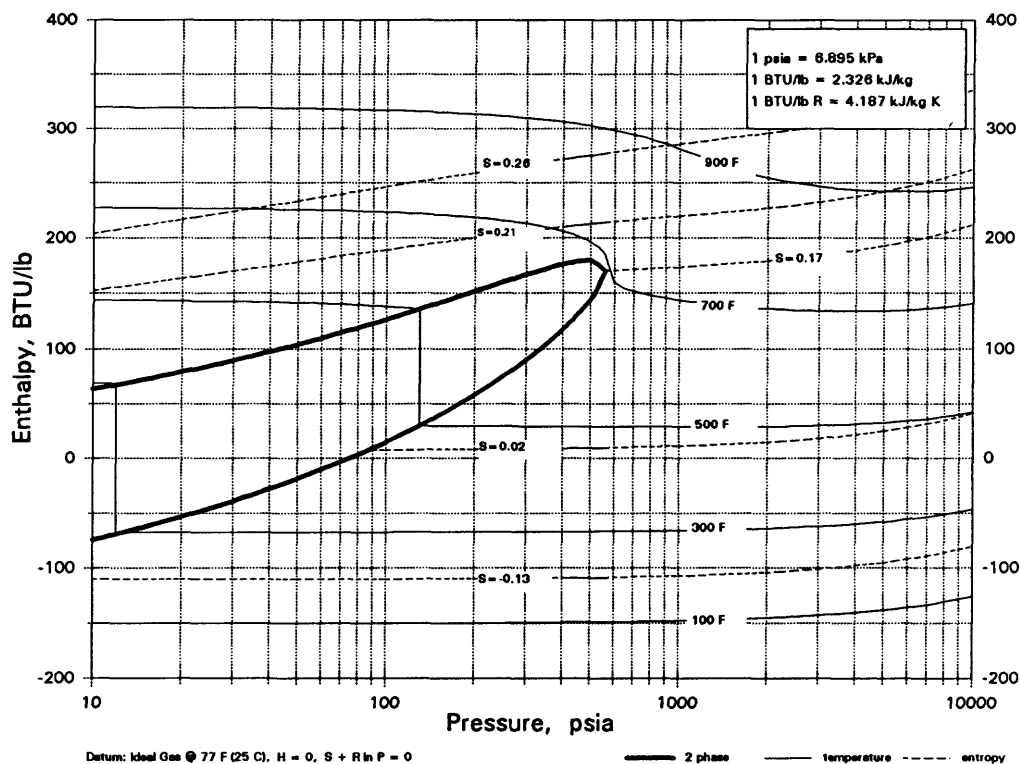
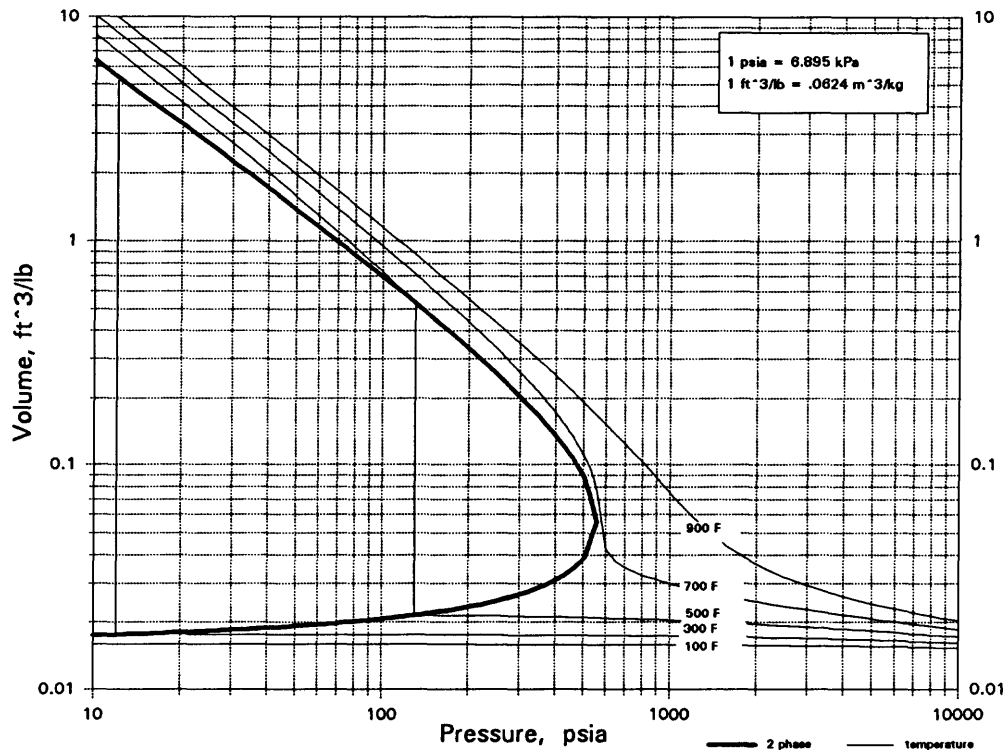


C4H10S
DIETHYL SULFIDE

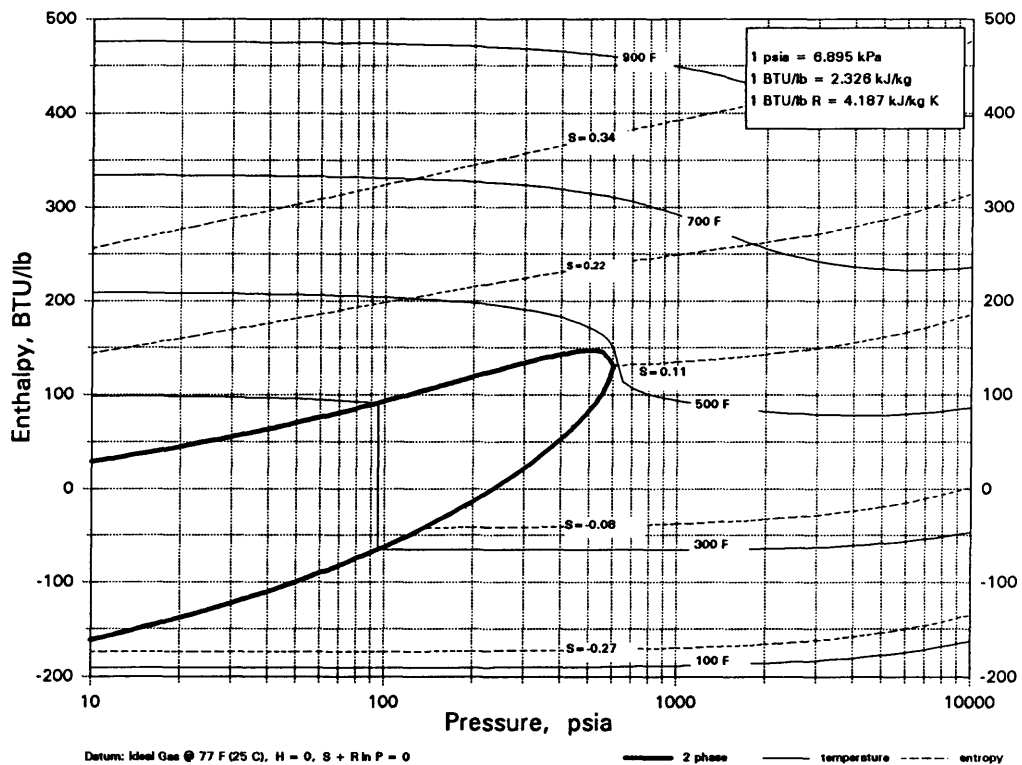
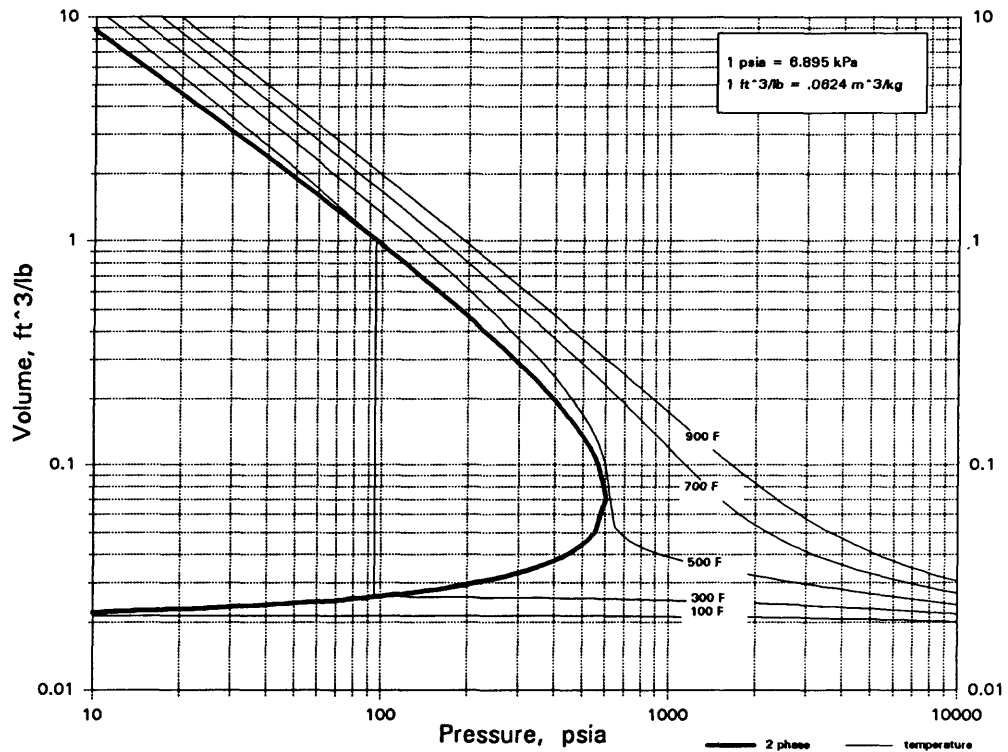


C4H10S2

DIETHYL DISULFIDE

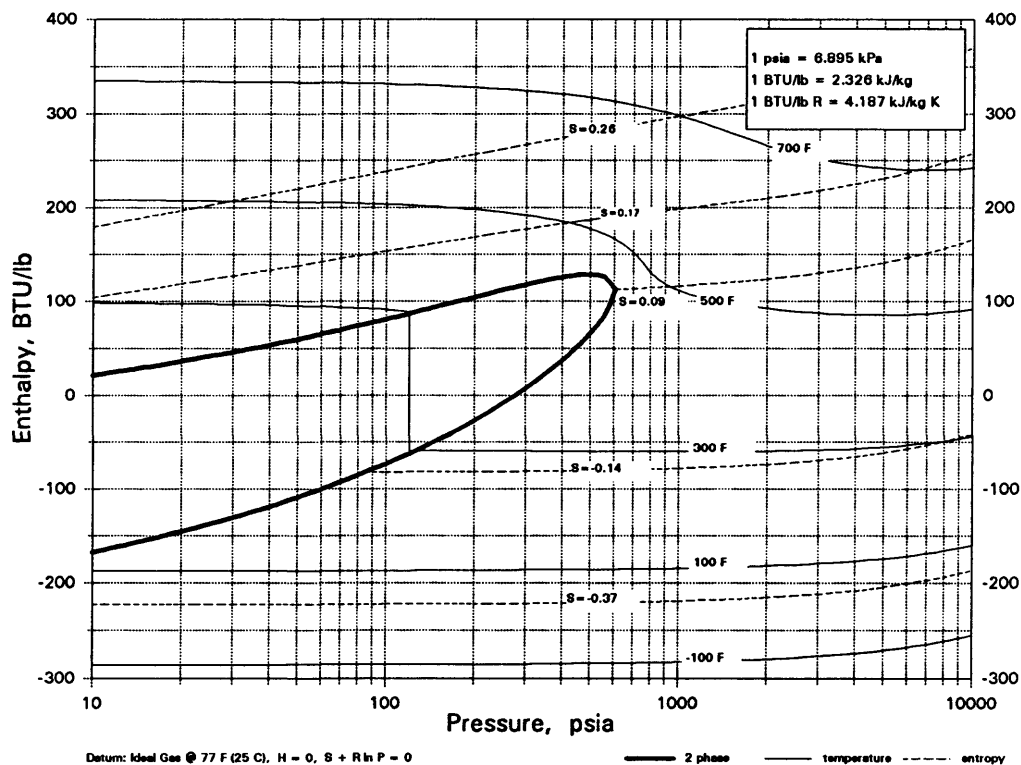
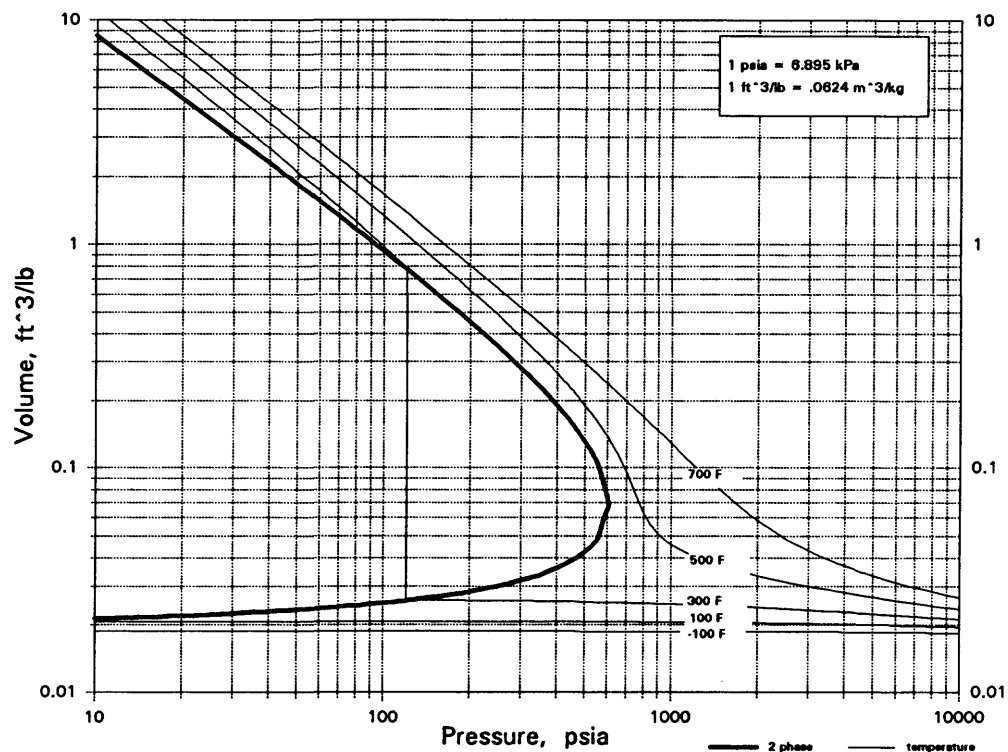


C4H11N
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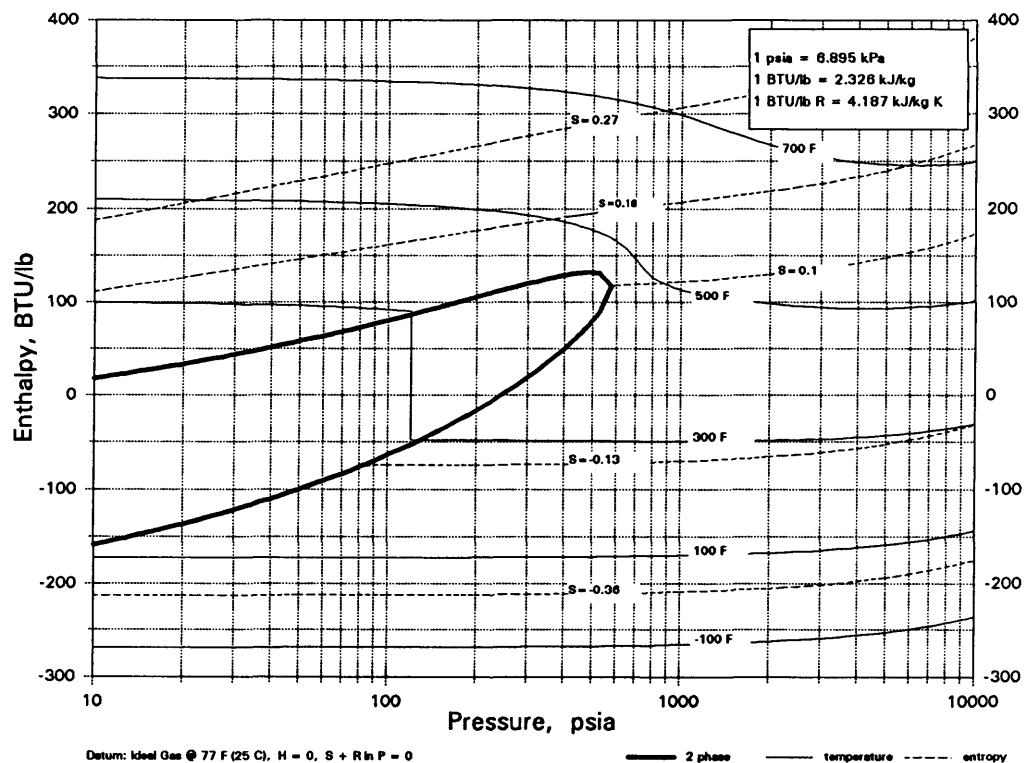
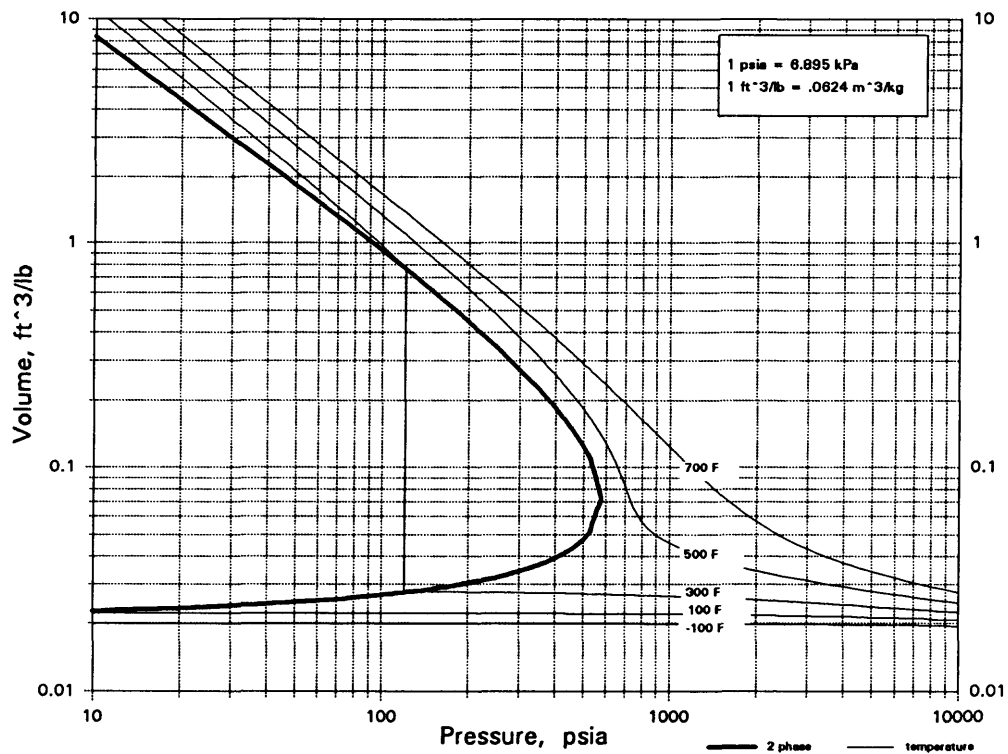
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ISOBUTYLAMINE



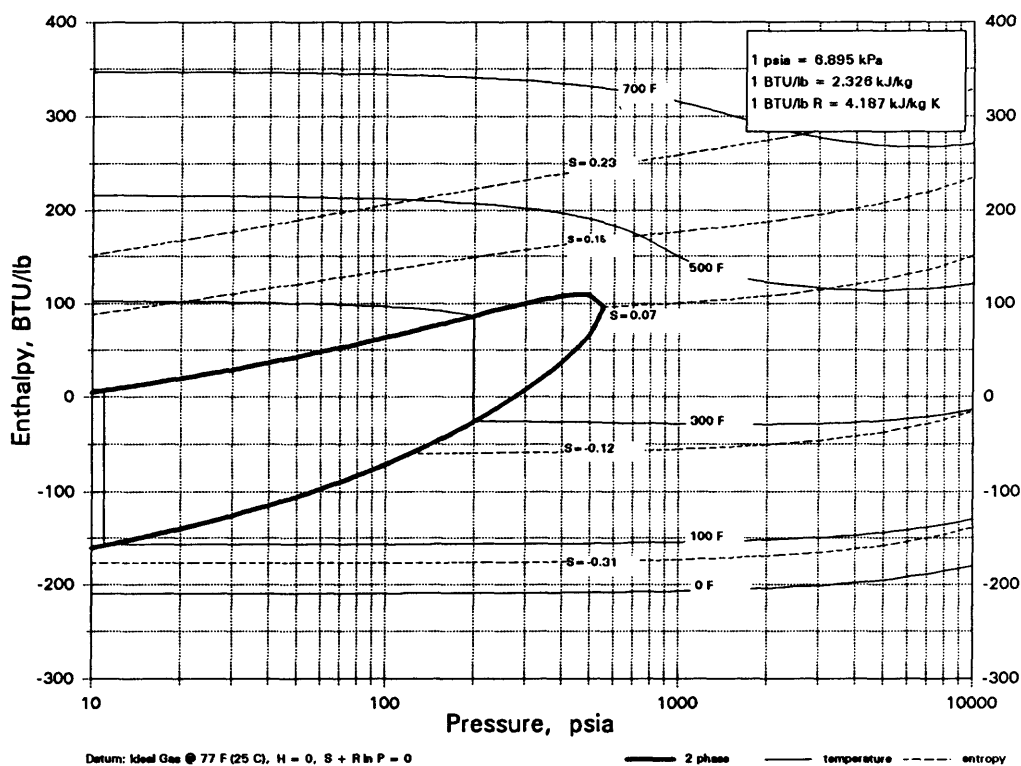
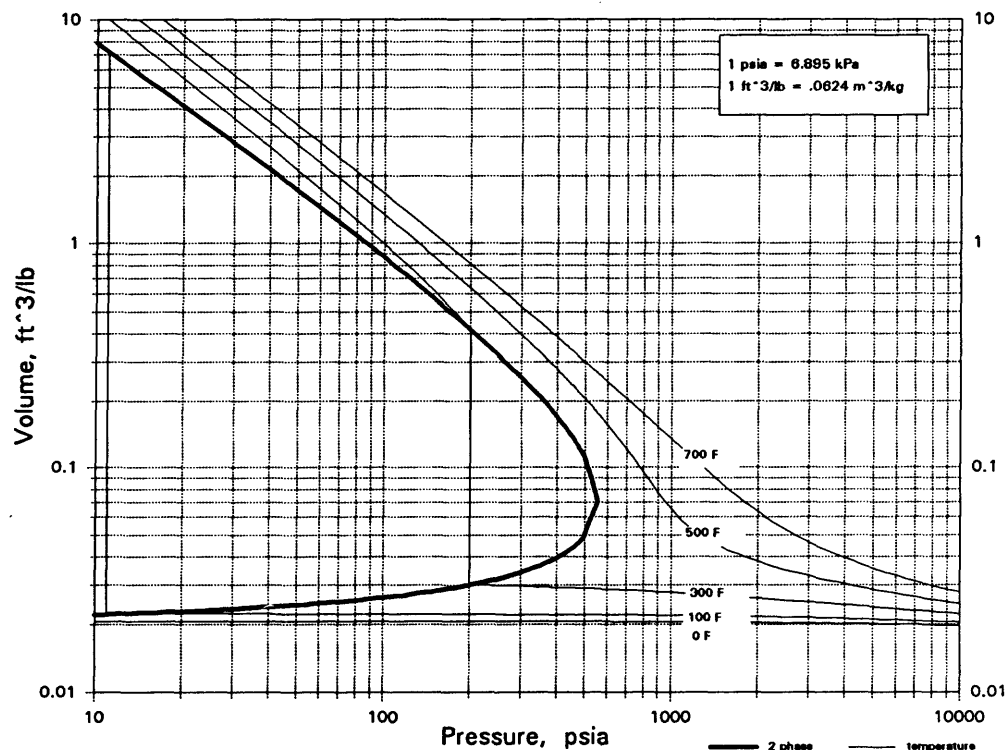
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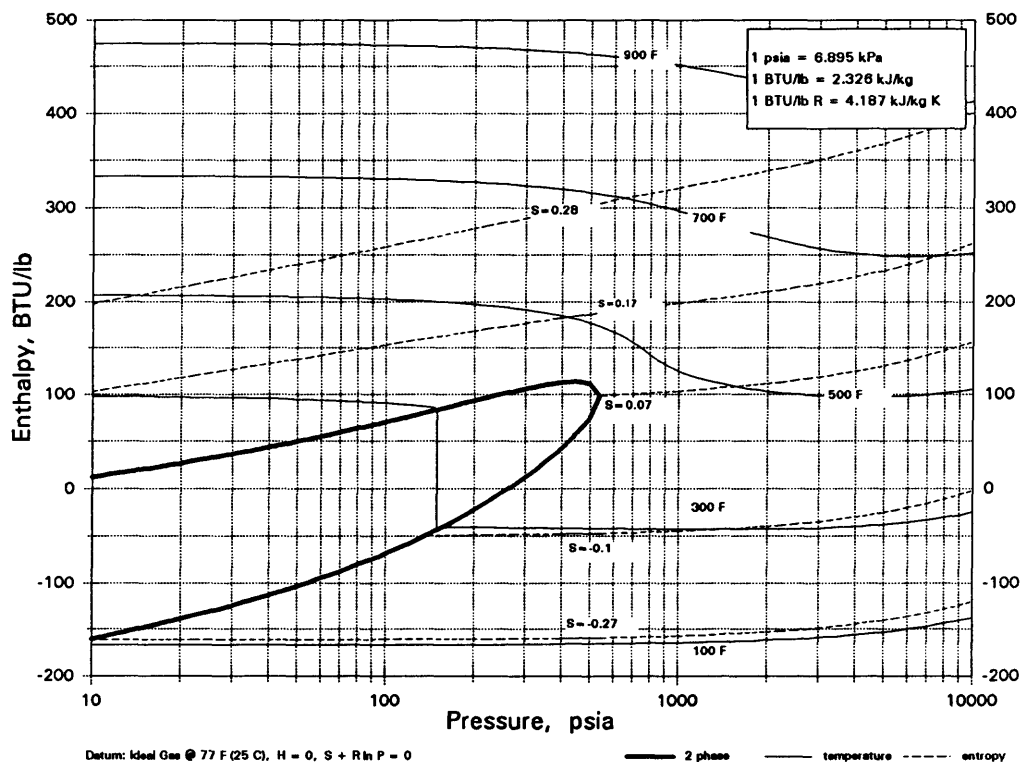
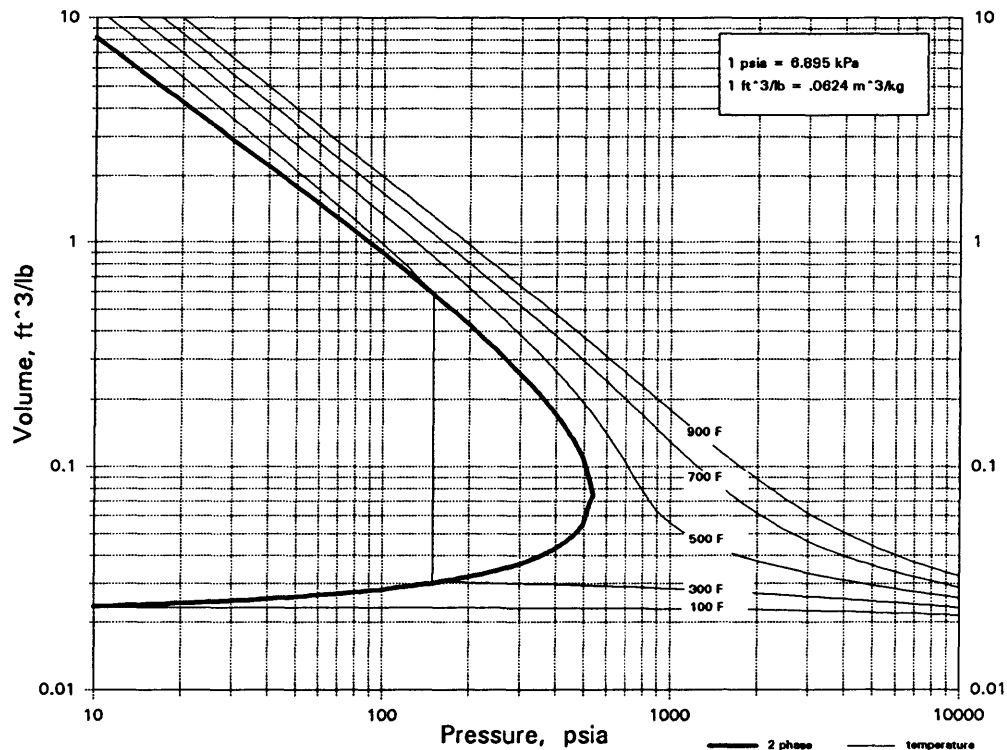
sec-BUTYLAMINE



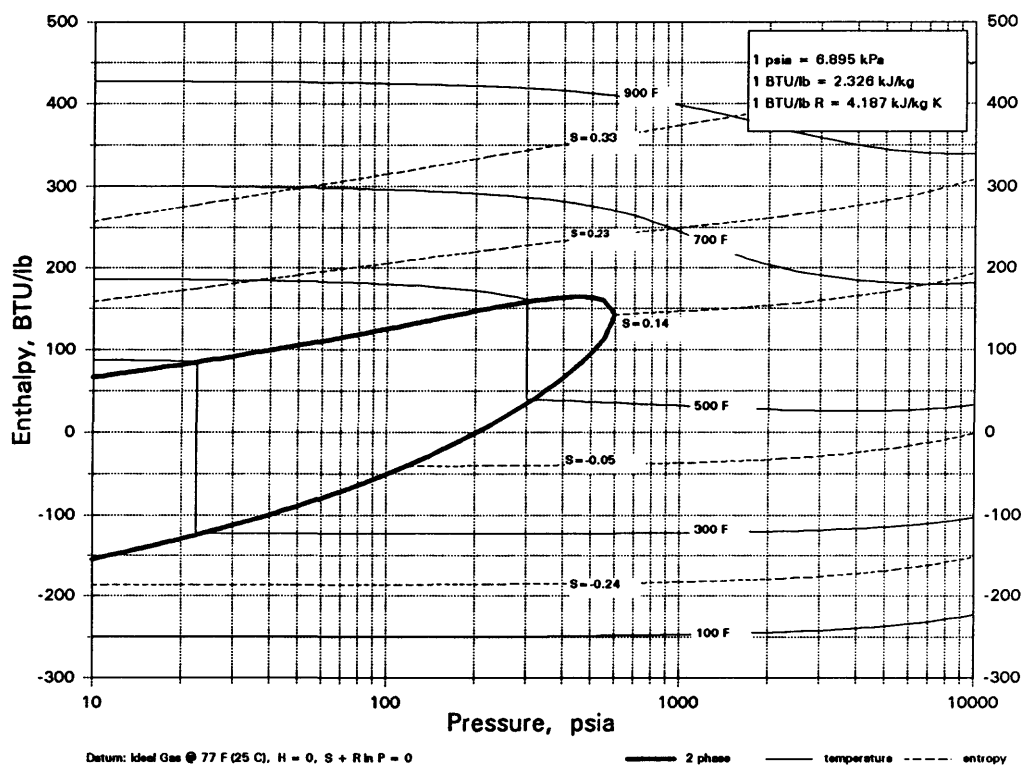
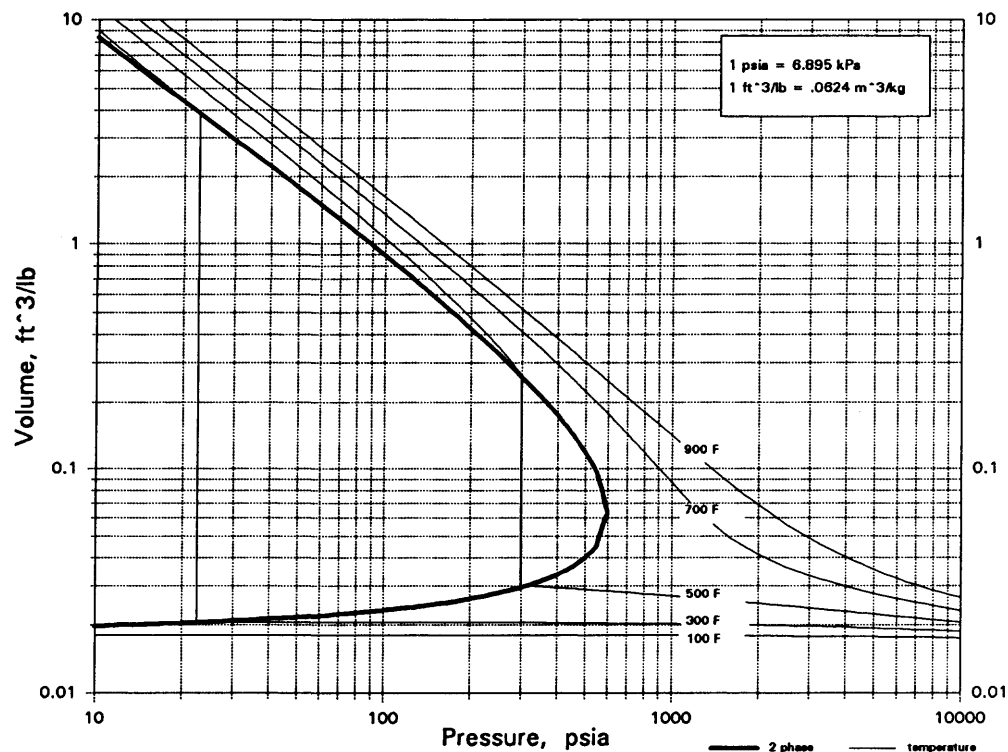
C4H11N

tert-BUTYLAMINE



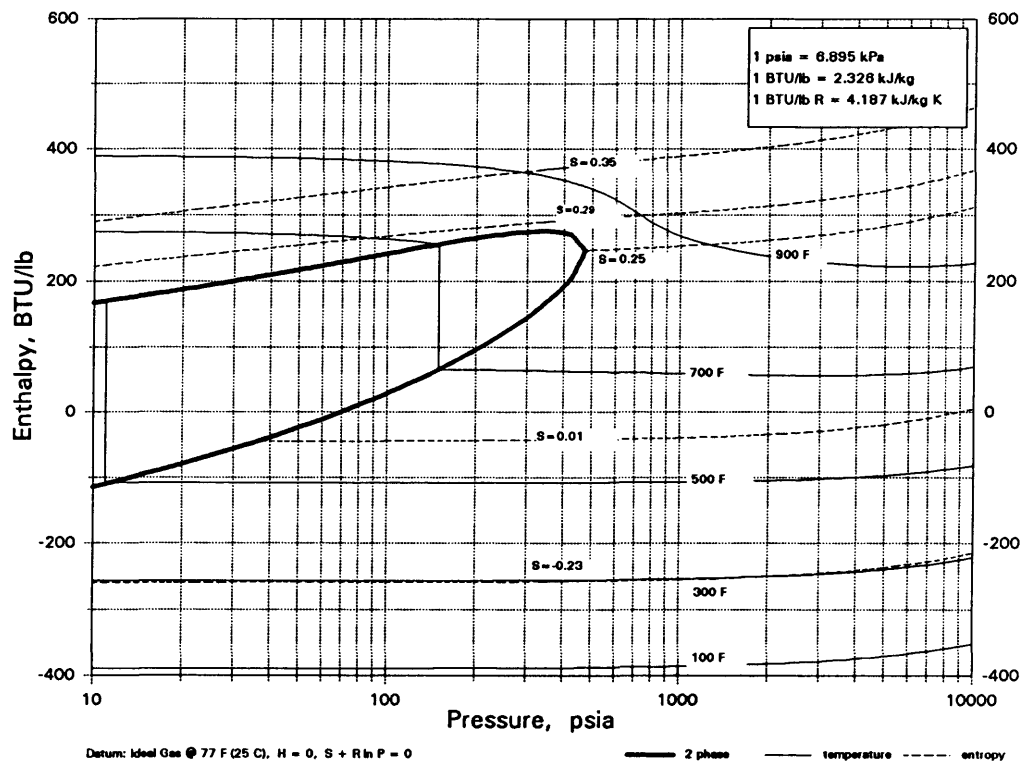
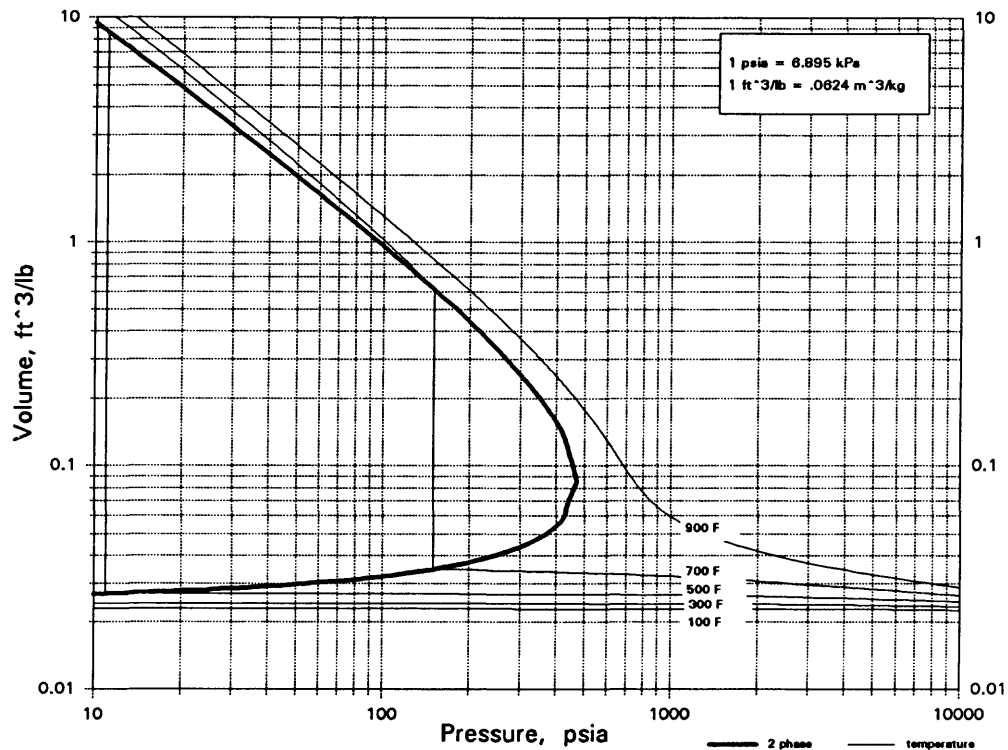
C4H11N**DIETHYLAMINE**

C4H11NO DIMETHYLETHANOLAMINE

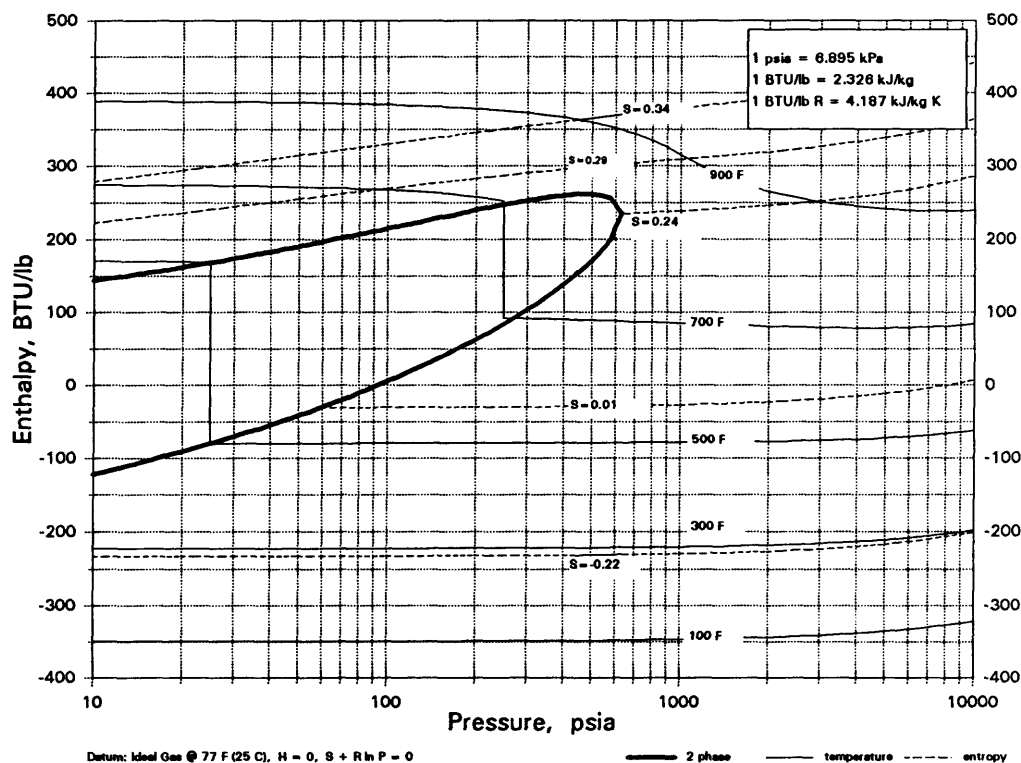
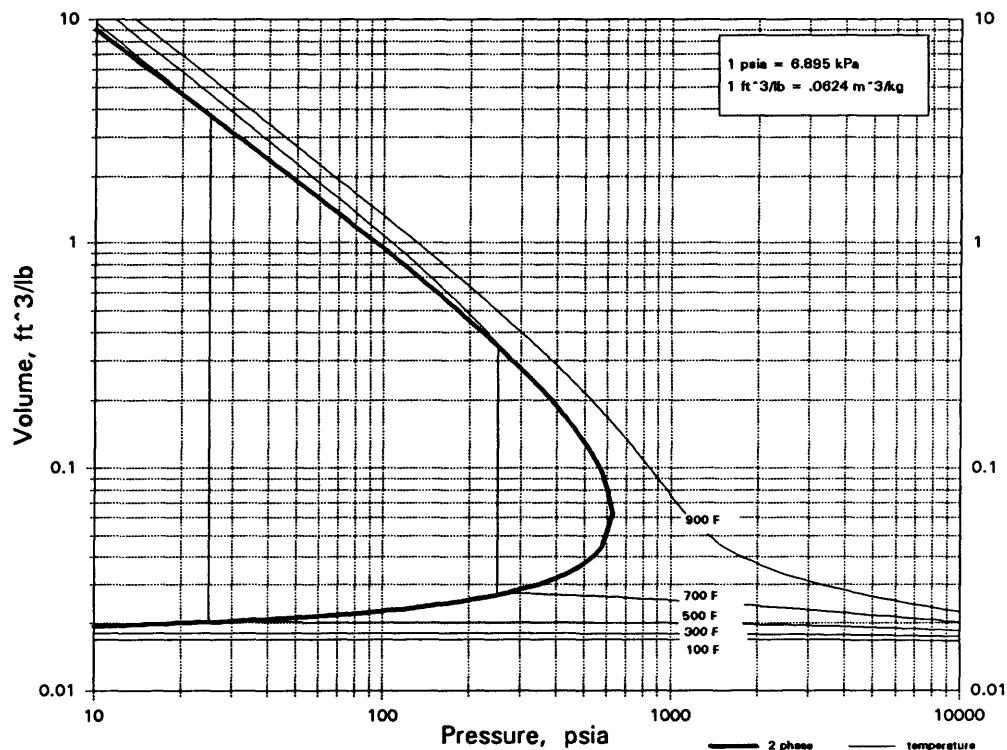


C₄H₁₁NO₂

DIETHANOLAMINE

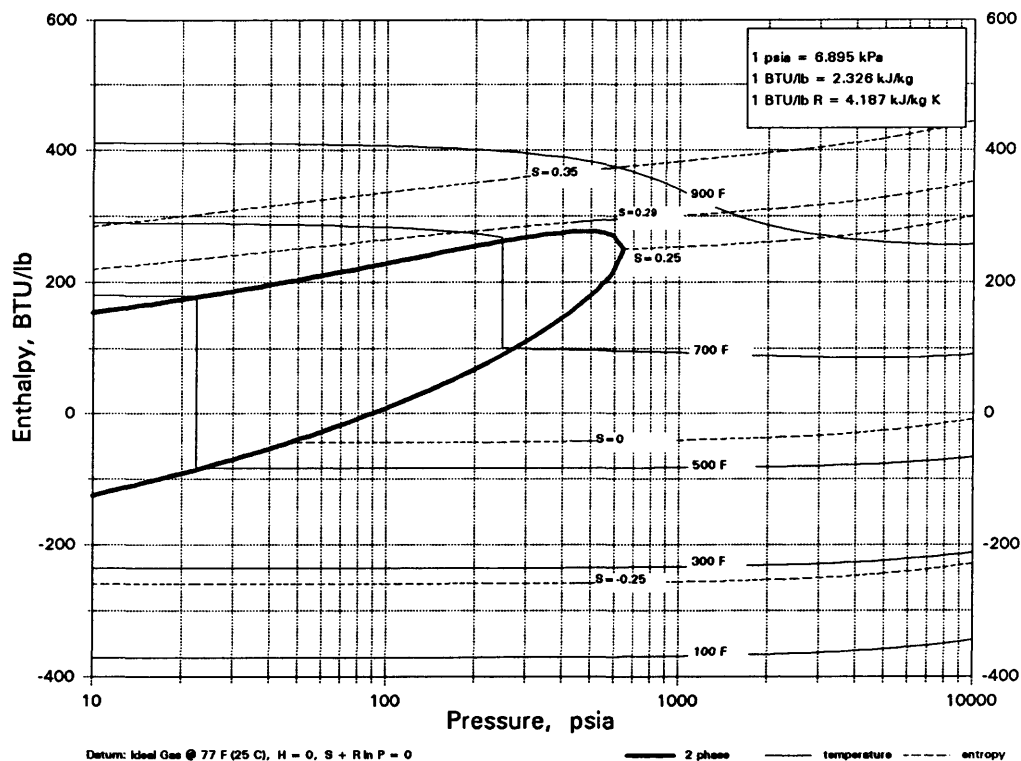
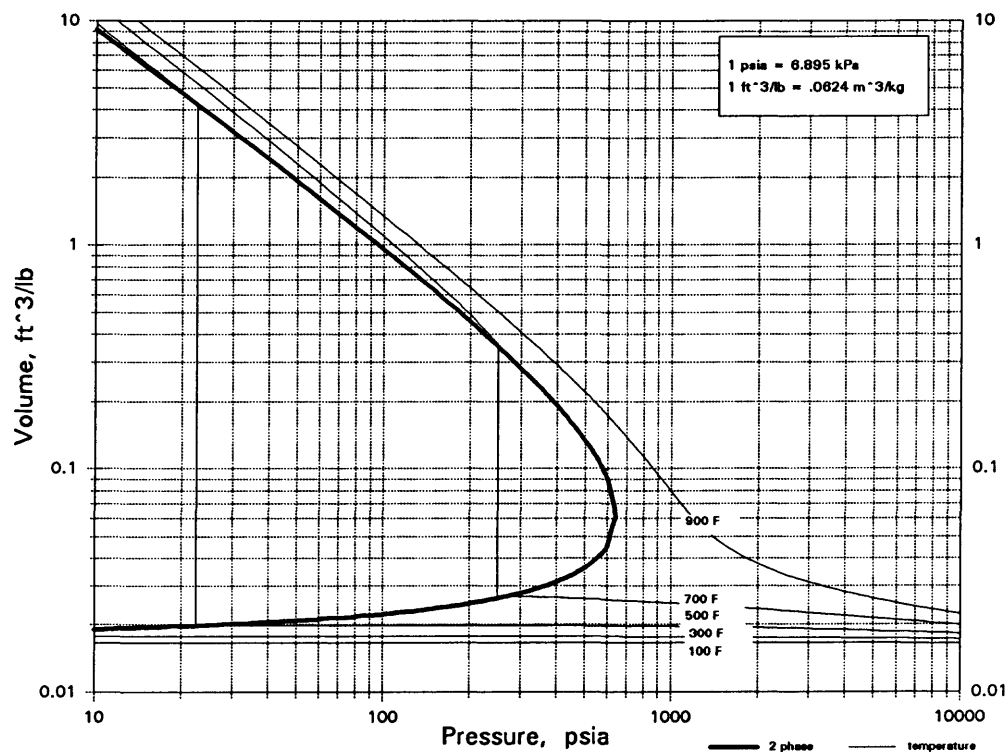


C4H11NO2 2-AMINOETHOXYETHANOL



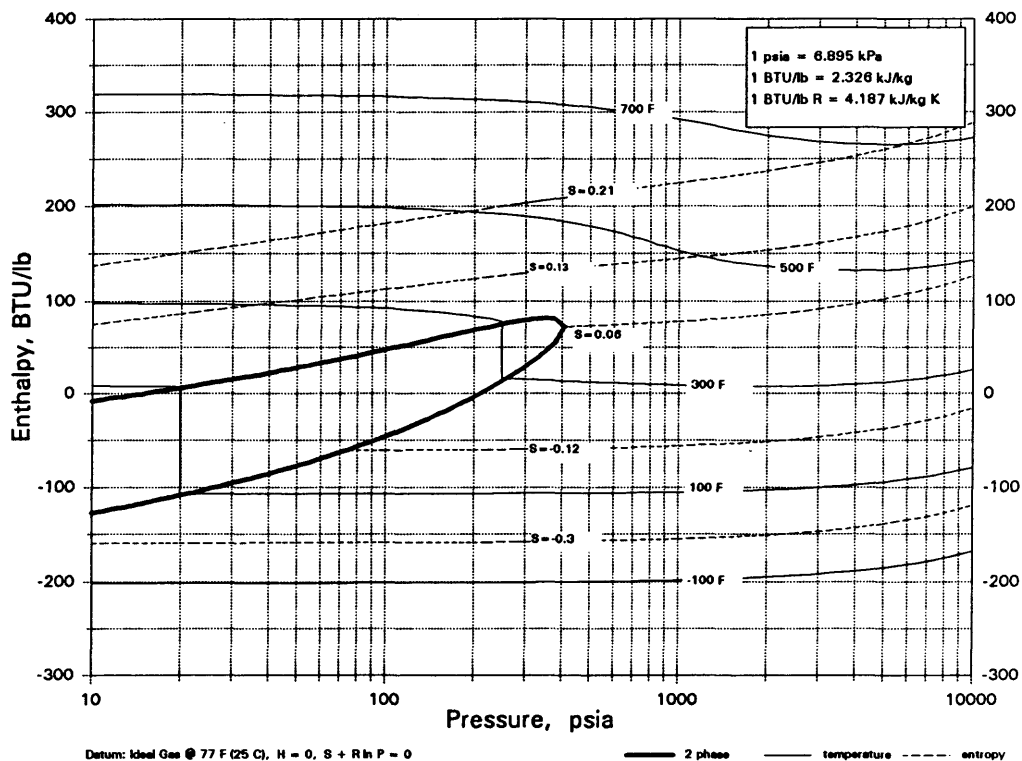
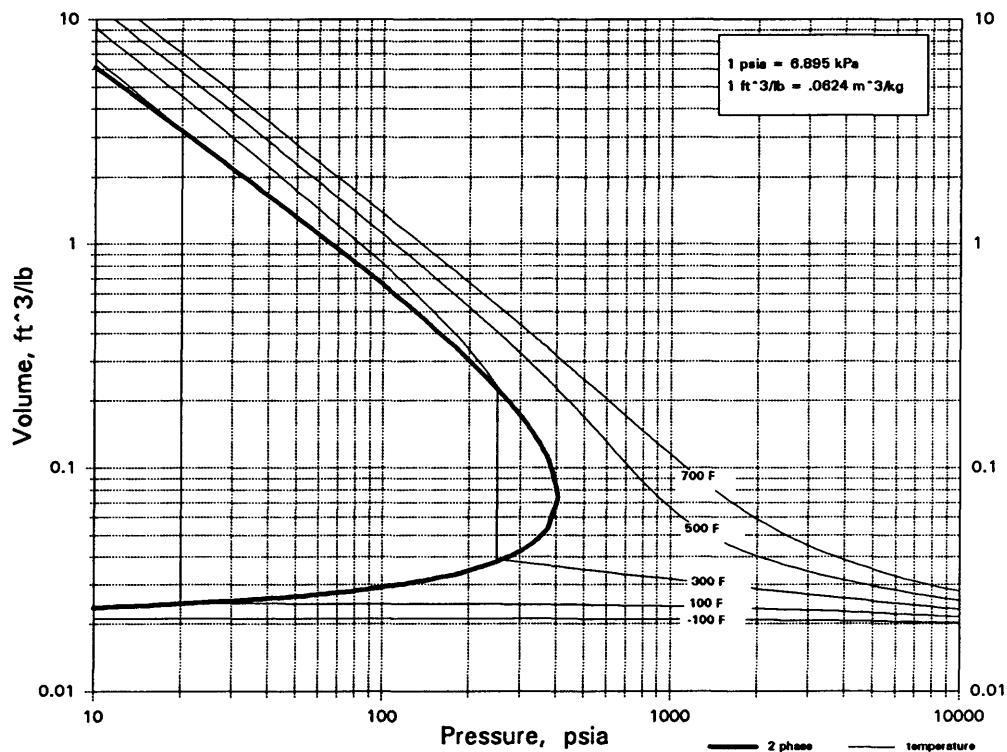
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N-AMINOETHYL ETHANOLAMINE



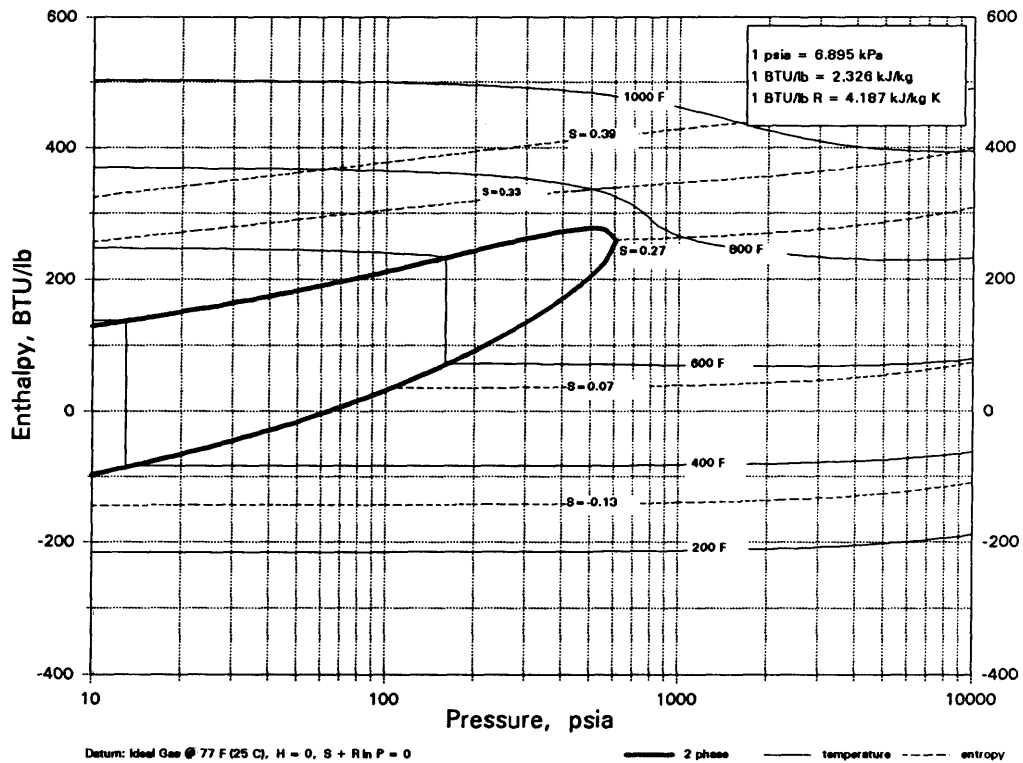
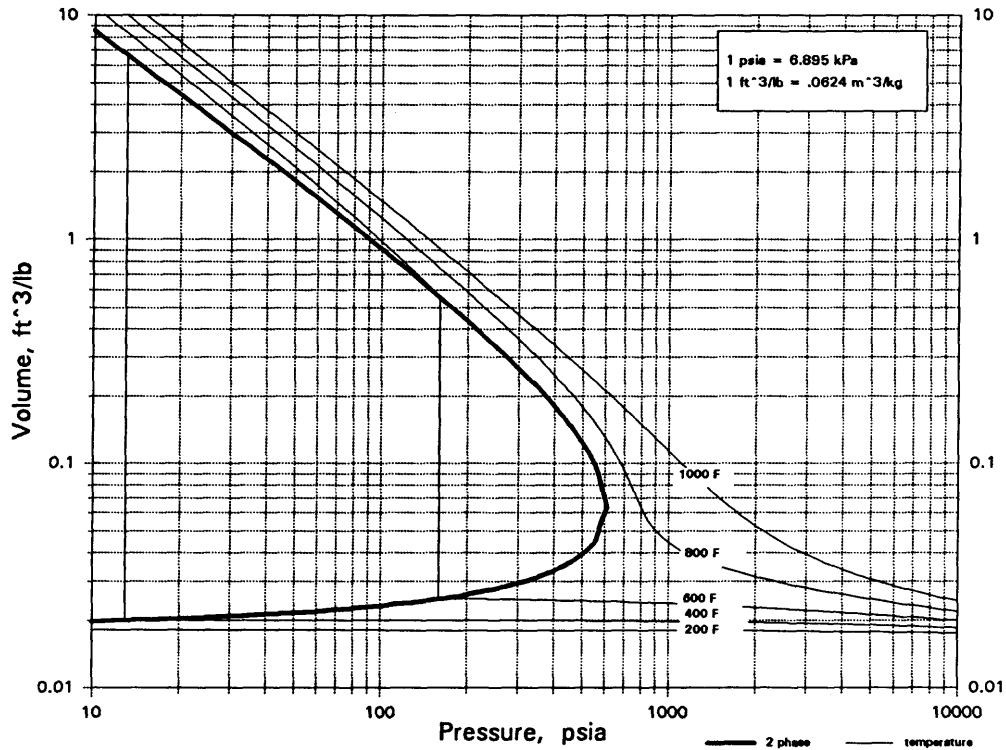
C₄H₁₂Si

TETRAMETHYLSILANE



C4H13N3

DIETHYLENE TRIAMINE



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Appendix A

Equations for Thermodynamic Properties

Enthalpy

$$H = H_{ref} + \int_{T_{ref}}^T C_P dT - \Delta H^{resid} \quad (1)$$

Entropy

$$S = S_{ref} + \int_{T_{ref}}^T \frac{C_P}{T} dT - R \ln\left(\frac{P}{P_{ref}}\right) - \Delta S^{resid} \quad (2)$$

Internal Energy

$$U = H - P V \quad (3)$$

Helmholtz Energy

$$A = U - T S \quad (4)$$

Gibbs Energy

$$G = H - T S \quad (5)$$

Parameters

$$C_P = \text{heat capacity of ideal gas} \quad (6)$$

$$H_{ref}, S_{ref} = \text{reference state for ideal gas} \quad (7)$$

$$T_{ref}, P_{ref} = \text{reference temperature, reference pressure} \quad (8)$$

$$\Delta H^{resid}, \Delta S^{resid} = \text{residual enthalpy, residual entropy} \quad (9)$$

Appendix B

Peng-Robinson Equation of State for Thermodynamic Properties

Equation of State

$$P = \frac{RT}{V - b} - \frac{a}{V(V + b) + b(V - b)} \quad (1)$$

Volume

$$V^3 + (b - \frac{RT}{P})V^2 + (\frac{a}{P} - 3b^2 - \frac{RT}{P}2b)V + (b^3 + \frac{RT}{P}b^2 - \frac{ab}{P}) = 0 \quad (2)$$

Compressibility Factor

$$Z^3 - (1 - B)Z^2 + (A - 3B^2 - 2B)Z - (AB - B^2 - B^3) = 0 \quad (3)$$

Fugacity Coefficient

$$\ln \phi = Z - 1 - \ln(Z - B) - \frac{A}{2\sqrt{2}B} \ln\left(\frac{Z + 2.414B}{Z - 0.414B}\right) \quad (4)$$

Residual Enthalpy

$$\frac{\Delta H^{resid}}{RT} = 1 - Z + \frac{A}{2\sqrt{2}B} \left(1 + \frac{D}{a}\right) \ln\left(\frac{Z + 2.414B}{Z - 0.414B}\right) \quad (5)$$

Residual Entropy

$$\frac{\Delta S^{resid}}{R} = -\ln(Z - B) + \frac{AD}{2\sqrt{2}Ba} \ln\left(\frac{Z + 2.414B}{Z - 0.414B}\right) \quad (6)$$

Parameters

$$a = a_c \alpha \quad (7)$$

$$a_c = 0.45724R^2T_c^2/P_c \quad (8)$$

$$b = 0.07780RT_c/P_c \quad (9)$$

$$\alpha = [1 + m(1 - T_r^{1/2})]^2 \quad (10)$$

$$m = 0.37464 + 1.54226\Omega - 0.26992\Omega^2 \text{ (original PR)} \quad (11)$$

$$m = \text{see Stryjek , Vera (modified PR)} \quad (12)$$

$$A = aP/R^2T^2 = 0.45724\alpha P_r/T_r^2 = 0.45724 \frac{(P/P_c)}{(T/T_c)^2} \alpha \quad (13)$$

$$B = bP/RT = 0.07780P_r/T_r = 0.07780 \frac{(P/P_c)}{(T/T_c)} \quad (14)$$

$$D = -T \frac{da}{dT} = ma\sqrt{T_r/\alpha} \quad (15)$$

Appendix C

Examples for Thermodynamic Diagrams

Example 1 - Vessel Pressure

A vessel containing ethylene (C₂H₄) at 300 psia and 0 F is exposed to a fire in the process area. The temperature in the vessel is 600 F when the fire is extinguished. Estimate the final pressure in the vessel.

Since the vessel size does not change appreciably, this situation maybe approximated by a constant volume process. Using the thermodynamic diagram, the initial volume is about 0.43 ft³/lb. At this same volume and final temperature of 600 F, the pressure is:

$$P_{\text{final}} = 900 \text{ psia}$$

Example 2 - Reactor Size

A batch reactor is to contain 2,000 lb of ethylene (C₂H₄) at 1,000 psia and 200 F. Estimate the reactor size.

Using the thermodynamic diagram, the volume is about 0.2 ft³/lb of ethylene at these conditions. Substitution of this into the equation below for the reactor size provides:

$$\text{Reactor Size} = (2,000 \text{ lb}) (0.2 \text{ ft}^3/\text{lb}) = 400 \text{ ft}^3$$

Example 3 - Process Vessel Size

A process vessel is to contain 500 lb of ethylene (C₂H₄) at 200 psia and 0 F. Estimate the process vessel size.

Using the thermodynamic diagram, the volume is about 0.75 ft³/lb of ethylene at these conditions. Substitution of this into the equation below for the process vessel size provides:

$$\text{Vessel Size} = (500 \text{ lb}) (0.75 \text{ ft}^3/\text{lb}) = 375 \text{ ft}^3$$

Example 4 - Heat Exchanger Duty

Ethylene (C₂H₄, 30,000 lb/hr) at 1,000 psia and 0 F is heated to 600 F and then fed to a plug-flow reactor. Estimate the heat exchanger duty necessary to accomplish the heating.

Substitution of mass flow and enthalpies from the thermodynamic diagram into the equation below provides:

$$\begin{aligned} \text{Heat Exchanger Duty} &= \text{mass flow } (H_2 - H_1) = (30,000 \text{ lb/hr})(240 - (-180)) \text{ BTU/lb} \\ &= \underline{12.6 \text{ million BTU/hr}} \end{aligned}$$

Example 5 - Compression

Ethylene (C₂H₄, 20,000 lb/hr) at 30 psia and 10 F is compressed to 3,000 psia. Estimate the change in enthalpy for the compression assuming adiabatic and reversible conditions (constant entropy).

Substitution of mass flow and enthalpies from the thermodynamic diagram into the equation below provides:

$$\begin{aligned}\text{Enthalpy Change} &= \text{mass flow } (H_2 - H_1) = (20,000 \text{ lb/hr})(200 - (-20)) \text{ BTU/lb} \\ &= \underline{4.4 \text{ million BTU/hr}}\end{aligned}$$

This change in enthalpy represents energy that is required to accomplish the compression under adiabatic and reversible conditions. Under operating conditions, the actual energy that is required for the compression will be somewhat more depending on the efficiency.

Example 6 - Expansion

Ethylene (C₂H₄, 30,000 lb/hr) at 850 psia and 400 F is expanded to 10 psia. Estimate the change in enthalpy for the expansion assuming adiabatic and reversible conditions (constant entropy).

Substitution of mass flow and enthalpies from the thermodynamic diagram into the equation below provides:

$$\begin{aligned}\text{Enthalpy Change} &= \text{mass flow } (H_2 - H_1) = (30,000 \text{ lb/hr})(-60 - 125) \text{ BTU/lb} \\ &= \underline{-5.55 \text{ million BTU/hr}}\end{aligned}$$

This change in enthalpy represents energy that is available from the expansion under adiabatic and reversible conditions. Under operating conditions, the actual energy that is available for the expansion will be somewhat less depending on the efficiency.

Appendix D

CRITICAL CONSTANTS AND ACENTRIC FACTOR FOR C₁ TO C₄ COMPOUNDS

Carl L. Yaws
Lamar University, Beaumont, Texas

NO	FORMULA	NAME	MW g/mol	T _F K	T _B K	T _C K	P _C bar	V _C cm ³ /mol	ρ _C g/cm ³	Z _C	ω
1	CBrClF ₂	BROMOCHLORODIFLUOROMETHANE	165.365	113.65	269.14	426.15	42.54	246.0	0.6722	0.295	0.187
2	CBrCl ₃	BROMOTRICHLOROMETHANE	198.273	252.15	378.05	606.00	49.70	284.0	0.6981	0.280	0.192
3	CBrF ₃	BROMOTRIFLUOROMETHANE	148.910	105.15	215.26	340.15	39.72	200.0	0.7446	0.281	0.173
4	CBr ₂ F ₂	DIBROMODIFLUOROMETHANE	209.816	163.05	295.94	478.00	53.30	249.0	0.8426	0.334	0.200
5	CClF ₃	CHLOROTRIFLUOROMETHANE	104.459	92.15	191.74	301.96	39.46	180.3	0.5794	0.283	0.180
6	CClN	CYANOGEN CHLORIDE	61.470	266.65	286.00	449.00	59.90	163.0	0.3771	0.262	0.320
7	CCl ₂ F ₂	DICHLORODIFLUOROMETHANE	120.913	115.15	243.36	384.95	41.25	217.0	0.5572	0.280	0.180
8	CCl ₂ O	PHOSGENE	98.916	145.37	280.71	455.00	56.74	190.2	0.5200	0.285	0.201
9	CCl ₃ F	TRICHLOROFLUOROMETHANE	137.368	162.04	296.97	471.20	44.08	248.0	0.5539	0.279	0.184
10	CCl ₄	CARBON TETRACHLORIDE	153.822	250.33	349.79	556.35	45.60	276.0	0.5573	0.272	0.193
11	CF ₂ O	CARBONYL FLUORIDE	66.007	161.89	188.58	297.00	57.60	141.0	0.4681	0.329	0.283
12	CF ₄	CARBON TETRAFLUORIDE	88.005	89.56	145.09	227.50	37.39	140.0	0.6286	0.277	0.186
13	CHBr ₃	TRIBROMOMETHANE	252.731	281.20	422.35	696.00	60.90	286.0	0.8837	0.301	0.156
14	CHClF ₂	CHLORODIFLUOROMETHANE	86.468	115.73	232.32	369.30	49.71	166.0	0.5209	0.269	0.219
15	CHCl ₂ F	DICHLOROFLUOROMETHANE	102.923	138.15	282.05	451.58	51.84	196.0	0.5251	0.271	0.207
16	CHCl ₃	CHLOROFORM	119.377	209.63	334.33	536.40	54.72	239.0	0.4995	0.293	0.213
17	CHF ₃	TRIFLUOROMETHANE	70.014	117.97	190.99	298.89	48.36	133.3	0.5252	0.259	0.267
18	CHN	HYDROGEN CYANIDE	27.026	259.91	298.85	456.65	53.91	138.6	0.1950	0.197	0.410
19	CH ₂ BrCl	BROMOCHLOROMETHANE	129.384	185.20	341.20	557.00	68.10	188.0	0.6882	0.276	0.220
20	CH ₂ Br ₂	DIBROMOMETHANE	173.835	220.60	370.10	611.00	71.70	223.0	0.7795	0.315	0.210
21	CH ₂ Cl ₂	DICHLOROMETHANE	84.932	178.01	312.90	510.00	60.80	185.0	0.4591	0.265	0.192
22	CH ₂ F ₂	DIFLUOROMETHANE	52.024	137.00	221.50	351.60	58.30	121.0	0.4300	0.241	0.276
23	CH ₂ I ₂	DIIODOMETHANE	267.836	279.25	455.15	747.00	54.70	272.0	0.9847	0.240	0.141
24	CH ₂ O	FORMALDEHYDE	30.026	181.15	254.05	408.00	65.86	105.0	0.2860	0.204	0.282
25	CH ₂ O ₂	FORMIC ACID	46.026	281.55	373.71	580.00	73.90	125.0	0.3682	0.192	0.473
26	CH ₃ Br	METHYL BROMIDE	94.939	179.55	276.71	467.00	80.00	156.0	0.6086	0.321	0.192
27	CH ₃ Cl	METHYL CHLORIDE	50.488	175.45	248.93	416.25	66.79	139.0	0.3632	0.268	0.153
28	CH ₃ Cl ₃ Si	METHYL TRICHLOROSILANE	149.478	195.35	339.55	517.00	35.30	340.0	0.4396	0.279	0.263
29	CH ₃ F	METHYL FLUORIDE	34.033	131.35	194.82	317.70	58.77	113.0	0.3012	0.251	0.204
30	CH ₃ I	METHYL IODIDE	141.939	206.70	315.58	528.00	73.70	185.0	0.7672	0.311	0.193
31	CH ₃ NO	FORMAMIDE	45.041	275.70	493.00	771.00	78.00	163.0	0.2763	0.198	0.453
32	CH ₃ NO ₂	NITROMETHANE	61.040	244.60	374.35	588.15	63.13	173.4	0.3520	0.224	0.348
33	CH ₄	METHANE	16.043	90.67	111.66	190.58	46.04	99.3	0.1616	0.288	0.011
34	CH ₄ Cl ₂ Si	METHYL DICHLOROSILANE	115.034	182.55	314.70	483.00	39.50	289.0	0.3980	0.284	0.276
35	CH ₄ O	METHANOL	32.042	175.47	337.85	512.58	80.96	117.8	0.2720	0.224	0.566
36	CH ₄ O ₃ S	METHANESULFONIC ACID	96.107	292.81	561.00	---	---	220.0	0.4369	---	---
37	CH ₄ S	METHYL MERCAPTAN	48.109	150.18	279.11	469.95	72.35	145.0	0.3318	0.268	0.146
38	CH ₅ Cl ₃ Si	METHYL CHLOROSILANE	80.589	139.05	281.85	442.00	41.70	246.0	0.3276	0.279	0.225
39	CH ₅ N	METHYLAMINE	31.057	179.69	266.82	430.05	74.58	154.0	0.2017	0.321	0.281
40	CH ₆ Si	METHYL SILANE	46.144	116.34	216.25	352.50	48.40	205.0	0.2251	0.339	0.139
41	CN ₄ O ₈	TETRANITROMETHANE	196.033	287.05	398.85	540.00	17.40	468.0	0.4189	0.181	0.516
42	CO	CARBON MONOXIDE	28.010	68.15	81.70	132.92	34.99	93.1	0.3009	0.295	0.066
43	COS	CARBONYL SULFIDE	60.076	134.35	223.00	378.80	63.49	135.1	0.4447	0.272	0.097
44	CO ₂	CARBON DIOXIDE	44.010	216.58	194.67	304.19	73.82	94.0	0.4682	0.274	0.228
45	CS ₂	CARBON DISULFIDE	76.143	161.58	319.37	552.00	79.03	160.0	0.4759	0.276	0.108
46	C ₂ BrF ₃	BROMOTRIFLUOROETHYLENE	160.921	---	270.65	432.00	44.80	239.0	0.6733	0.298	0.175
47	C ₂ Br ₂ F ₄	1-2-DIBROMOTETRAFLUOROETHANE	259.824	162.65	320.41	487.80	33.93	341.0	0.7619	0.285	0.250
48	C ₂ ClF ₃	CHLOROTRIFLUOROETHYLENE	116.470	115.00	245.30	379.15	40.53	212.0	0.5494	0.273	0.264
49	C ₂ ClF ₅	CHLOROPENTAFLUOROETHANE	154.467	173.71	234.04	353.15	31.57	252.0	0.6130	0.271	0.251
50	C ₂ Cl ₂ F ₄	1-2-DICHLOROTETRAFLUOROETHANE	170.921	179.15	276.92	418.85	32.63	293.7	0.5820	0.275	0.252
51	C ₂ Cl ₃ F ₃	1-1-2-TRICHLOROTRIFLUOROETHANE	187.375	238.15	320.75	487.25	34.15	325.3	0.5760	0.274	0.255
52	C ₂ Cl ₄	TETRACHLOROETHYLENE	165.833	250.80	394.40	620.00	44.90	248.0	0.6687	0.216	0.214
53	C ₂ Cl ₄ F ₂	1-1-2-2-TETRACHLORODIFLUOROETHANE	203.830	299.15	366.00	551.00	33.40	351.0	0.5807	0.264	0.291
54	C ₂ Cl ₄ O	TRICHLOROACETYL CHLORIDE	181.832	---	391.15	590.00	41.00	332.0	0.5477	0.277	0.348
55	C ₂ Cl ₆	HEXACHLOROETHANE	236.738	459.95	460.00	698.00	33.40	412.0	0.5746	0.237	0.221
56	C ₂ F ₄	TETRAFLUOROETHYLENE	100.016	142.00	197.51	306.45	39.44	172.0	0.5815	0.266	0.226
57	C ₂ F ₆	HEXAFLUROETHANE	138.012	172.45	194.95	292.80	29.79	224.0	0.6161	0.274	0.245
58	C ₂ HBrClF ₃	HALOTHANE	197.382	---	323.35	521.00	39.20	296.0	0.6668	0.268	0.091
59	C ₂ HClF ₂	2-CHLORO-1-1-DIFLUOROETHYLENE	98.479	134.65	254.55	400.55	44.58	197.0	0.4999	0.264	0.219
60	C ₂ HCl ₃	TRICHLOROETHYLENE	131.388	188.40	360.10	571.00	49.10	256.0	0.5132	0.265	0.217
61	C ₂ HCl ₃ O	DICHLOROACETYL CHLORIDE	147.387	---	382.15	579.00	46.10	288.0	0.5118	0.276	0.371
62	C ₂ HCl ₃ O	TRICHLOROACETALDEHYDE	147.387	216.00	370.85	565.00	44.10	288.0	0.5118	0.270	0.332
63	C ₂ HCl ₅	PENTACHLOROETHANE	202.293	244.15	433.03	665.00	36.80	369.0	0.5482	0.246	0.246

NO	FORMULA	NAME	MW g/mol	T _F K	T _B K	T _C K	P _C bar	V _G cm ³ /mol	ρ _C g/cm ³	Z _C	ω
64	C2HF3O2	TRIFLUOROACETIC ACID	114.024	257.90	344.95	491.25	32.58	204.0	0.5589	0.163	0.524
65	C2HF5	PENTAFLUOROETHANE	120.022	170.15	225.15	342.00	34.40	216.0	0.5557	0.261	0.259
66	C2H2	ACETYLENE	26.038	192.40	189.00	308.32	61.39	113.0	0.2305	0.271	0.187
67	C2H2Br4	1-1-2-2-TETRABROMOETHANE	345.654	273.15	516.65	824.00	46.00	401.0	0.8620	0.269	0.177
68	C2H2Cl2	1-1-DICHLOROETHYLENE	96.943	150.65	304.71	482.00	51.90	224.0	0.4328	0.290	0.272
69	C2H2Cl2	cis-1-2-DICHLOROETHYLENE	96.943	193.15	333.65	527.00	51.90	224.0	0.4328	0.265	0.264
70	C2H2Cl2	trans-1-2-DICHLOROETHYLENE	96.943	223.35	320.85	508.00	51.90	224.0	0.4328	0.275	0.264
71	C2H2Cl2O	CHLOROACETYL CHLORIDE	112.943	251.15	379.15	581.00	51.10	245.0	0.4610	0.259	0.358
72	C2H2Cl2O	DICHLOROACETALDEHYDE	112.943	223.00	362.00	555.00	49.50	245.0	0.4610	0.263	0.344
73	C2H2Cl2O2	DICHLOROACETIC ACID	128.942	286.55	467.15	686.00	51.70	265.0	0.4866	0.240	0.555
74	C2H2Cl3F	1-1-1-TRICHLOROFLUOROETHANE	151.394	---	366.00	565.00	39.90	294.0	0.5149	0.250	0.250
75	C2H2Cl4	1-1-1-2-TETRACHLOROETHANE	167.849	202.94	403.65	624.00	40.20	325.0	0.5165	0.252	0.242
76	C2H2Cl4	1-1-2-2-TETRACHLOROETHANE	167.849	229.35	418.25	645.00	40.90	325.0	0.5165	0.248	0.259
77	C2H2F2	1-1-DIFLUOROETHYLENE	64.035	129.15	187.50	302.80	44.58	154.0	0.4158	0.273	0.139
78	C2H2F4	1-1-1-2-TETRAFLUOROETHANE	102.031	172.15	247.15	380.00	36.90	203.0	0.5026	0.237	0.239
79	C2H2O	KETENE	42.037	122.00	223.34	370.00	58.10	144.0	0.2919	0.272	0.126
80	C2H2O4	OXALIC ACID	90.036	462.65	569.00	804.00	70.20	205.0	0.4392	0.215	0.918
81	C2H3Br	VINYL BROMIDE	106.950	135.35	288.95	473.00	71.80	200.0	0.5348	0.365	0.282
82	C2H3Cl	VINYL CHLORIDE	62.499	119.36	259.78	432.00	56.70	179.0	0.3492	0.283	0.101
83	C2H3ClF2	1-CHLORO-1-1-DIFLUOROETHANE	100.495	142.35	263.14	410.20	41.24	231.0	0.4350	0.279	0.237
84	C2H3ClO	ACETYL CHLORIDE	78.498	160.30	323.90	508.00	57.40	196.0	0.4005	0.266	0.334
85	C2H3ClO	CHLOROACETALDEHYDE	78.498	---	358.00	555.00	53.70	201.0	0.3905	0.234	0.330
86	C2H3ClO2	CHLOROACETIC ACID	94.497	333.15	462.50	686.00	57.80	221.0	0.4276	0.224	0.551
87	C2H3ClO2	METHYL CHLOROFORMATE	94.497	---	344.00	525.00	53.60	221.0	0.4276	0.271	0.393
88	C2H3Cl3	1-1-1-TRICHLOROETHANE	133.404	242.75	347.23	545.00	42.96	281.0	0.4747	0.266	0.216
89	C2H3Cl3	1-1-2-TRICHLOROETHANE	133.404	236.50	387.00	602.00	44.80	281.0	0.4747	0.252	0.260
90	C2H3F	VINYL FLUORIDE	46.044	112.65	200.95	327.80	52.39	144.0	0.3198	0.277	0.189
91	C2H3F3	1-1-1-TRIFLUOROETHANE	84.041	161.85	225.75	346.25	37.58	194.0	0.4332	0.253	0.253
92	C2H3N	ACETONITRILE	41.053	229.32	354.75	545.50	48.33	173.0	0.2373	0.184	0.338
93	C2H3NO	METHYL ISOCYANATE	57.052	256.15	312.00	505.00	51.90	190.0	0.3003	0.235	0.175
94	C2H4	ETHYLENE	28.054	104.01	169.47	282.36	50.32	129.1	0.2174	0.277	0.085
95	C2H4Br2	1-1-DIBROMOETHANE	187.862	210.15	381.15	628.00	60.30	276.0	0.6807	0.319	0.125
96	C2H4Br2	1-2-DIBROMOETHANE	187.862	282.94	404.51	650.15	54.77	261.6	0.7182	0.265	0.207
97	C2H4Cl2	1-1-DICHLOROETHANE	98.959	176.19	330.45	523.00	50.66	240.0	0.4123	0.280	0.244
98	C2H4Cl2	1-2-DICHLOROETHANE	98.959	237.49	356.59	561.00	53.70	220.0	0.4498	0.253	0.288
99	C2H4Cl2O	BIS(CHLOROMETHYL)ETHER	114.959	231.65	378.00	579.00	45.80	258.0	0.4456	0.245	0.324
100	C2H4F2	1-1-DIFLUOROETHANE	66.051	156.15	247.35	386.60	44.99	181.0	0.3649	0.253	0.263
101	C2H4F2	1-2-DIFLUOROETHANE	66.051	---	303.65	476.00	43.40	202.0	0.3270	0.222	0.224
102	C2H4O	ACETALDEHYDE	44.053	150.15	293.55	461.00	55.50	157.0	0.2806	0.227	0.317
103	C2H4O	ETHYLENE OXIDE	44.053	161.45	283.85	469.15	71.94	140.3	0.3140	0.259	0.198
104	C2H4O2	ACETIC ACID	60.053	289.81	391.05	592.71	57.86	171.0	0.3512	0.201	0.462
105	C2H4O2	METHYL FORMATE	60.053	174.15	304.90	487.20	59.98	172.0	0.3491	0.255	0.254
106	C2H5Br	BROMOETHANE	108.966	154.55	311.50	503.80	62.32	214.9	0.5070	0.320	0.183
107	C2H5Cl	ETHYL CHLORIDE	64.514	136.75	285.42	460.35	52.69	200.0	0.3226	0.275	0.204
108	C2H5ClO	2-CHLOROETHANOL	80.514	205.65	401.75	585.00	59.20	212.0	0.3798	0.258	0.637
109	C2H5F	ETHYL FLUORIDE	48.060	129.95	235.45	375.31	50.28	164.0	0.2930	0.264	0.209
110	C2H5I	ETHYL IODIDE	155.966	162.05	345.45	561.00	59.90	238.0	0.6553	0.306	1.137
111	C2H5N	ETHYLENEIMINE	43.068	195.20	329.00	537.00	68.50	173.0	0.2489	0.265	0.089
112	C2H5NO	ACETAMIDE	59.068	354.15	494.30	761.00	66.00	215.0	0.2747	0.224	0.189
113	C2H5NO	N-METHYLFORMAMIDE	59.068	269.35	472.66	721.00	56.20	215.0	0.2747	0.202	0.192
114	C2H5NO2	NITROETHANE	75.067	183.63	387.22	593.00	51.60	236.0	0.3181	0.247	0.265
115	C2H6	ETHANE	30.070	90.35	184.55	305.42	48.80	147.9	0.2033	0.284	0.099
116	C2H6AlCl	DIMETHYLALUMINUM CHLORIDE	92.054	252.15	399.15	619.00	36.20	320.0	0.2877	0.225	0.183
117	C2H6O	DIMETHYL ETHER	46.069	131.66	248.31	400.10	53.70	170.0	0.2710	0.274	0.204
118	C2H6O	ETHANOL	46.069	159.05	351.44	516.25	63.84	166.9	0.2760	0.248	0.637
119	C2H6OS	DIMETHYL SULFOXIDE	78.135	291.67	462.15	726.00	56.50	227.0	0.3442	0.212	0.209
120	C2H6O2	ETHYLENE GLYCOL	62.068	260.15	470.45	645.00	75.30	191.0	0.3250	0.268	1.137
121	C2H6O4S	DIMETHYL SULFATE	126.133	241.35	461.95	758.00	51.60	293.0	0.4305	0.240	0.089
122	C2H6S	DIMETHYL SULFIDE	62.136	174.88	310.48	503.04	55.30	200.9	0.3093	0.266	0.189
123	C2H6S	ETHYL MERCAPTAN	62.136	125.26	308.15	499.15	54.90	207.0	0.3002	0.274	0.192
124	C2H6S2	DIMETHYL DISULFIDE	94.202	188.44	382.90	606.00	53.60	252.0	0.3738	0.268	0.265
125	C2H7N	DIMETHYLAMINE	45.084	180.96	280.03	437.65	53.09	187.0	0.2411	0.273	0.294
126	C2H7N	ETHYLAMINE	45.084	192.15	289.73	456.15	56.24	182.0	0.2477	0.270	0.285
127	C2H7NO	MONOETHANOLAMINE	61.084	283.65	444.15	638.00	68.70	225.0	0.2715	0.291	0.797
128	C2H8N2	ETHYLENEDIAMINE	60.099	284.29	390.41	593.00	62.90	264.0	0.2276	0.337	0.479
129	C2H8Si	DIMETHYL SILANE	60.171	122.93	253.55	402.00	35.60	258.0	0.2332	0.275	0.132
130	C2N2	CYANOGEN	52.036	245.25	252.00	400.15	59.78	195.0	0.2669	0.350	0.279
131	C3F6	HEXAFLUOROPROPYLENE	150.023	116.65	243.55	368.00	29.00	268.0	0.5598	0.254	0.204
132	C3F6O	HEXAFLUOROACETONE	166.023	151.15	245.88	357.14	28.37	329.0	0.5046	0.314	0.364
133	C3F8	OCTAFLUOROPROPANE	188.020	125.46	236.40	345.05	26.80	299.0	0.6288	0.279	0.326
134	C3H2N2	MALONONITRILE	66.062	304.90	491.50	715.00	40.40	248.0	0.2664	0.169	0.509
135	C3H3Cl	PROPARGYL CHLORIDE	74.510	---	331.00	541.00	53.00	211.0	0.3531	0.249	0.152
136	C3H3N	ACRYLONITRILE	53.064	189.63	350.50	535.00	44.80	212.0	0.2503	0.214	0.350

NO	FORMULA	NAME	MW g/mol	T _F K	T _B K	T _C K	P _C bar	V _C cm ³ /mol	ρ _C g/cm ³	Z _C	ω
137	C3H3NO	OXAZOLE	69.063	---	342.65	554.00	63.20	237.0	0.2914	0.325	0.233
138	C3H4	METHYLACETYLENE	40.065	170.45	249.94	402.39	56.28	164.0	0.2443	0.276	0.216
139	C3H4	PROPADIENE	40.065	136.87	238.65	393.15	54.70	162.0	0.2473	0.271	0.160
140	C3H4Cl2	2-3-DICHLOROPROPENE	110.970	191.50	365.75	577.00	43.80	277.0	0.4006	0.253	0.206
141	C3H4O	ACROLEIN	56.064	185.45	325.84	506.00	50.00	197.0	0.2846	0.234	0.320
142	C3H4O	PROPARGYL ALCOHOL	56.064	221.35	386.75	580.00	65.30	176.0	0.3185	0.238	0.555
143	C3H4O2	ACRYLIC ACID	72.064	286.65	414.15	615.00	56.60	208.0	0.3465	0.230	0.518
144	C3H4O2	BETA-PROPIOLACTONE	72.064	239.75	435.15	686.00	69.10	195.0	0.3696	0.236	0.345
145	C3H4O2	VINYL FORMATE	72.064	---	320.00	498.00	50.20	217.0	0.3321	0.263	0.285
146	C3H4O3	ETHYLENE CARBONATE	88.063	309.55	511.15	790.00	67.70	193.0	0.4563	0.199	0.416
147	C3H4O3	PYRUVIC ACID	88.063	286.75	438.15	634.52	56.50	239.0	0.3685	0.256	0.670
148	C3H5Cl	2-CHLOROPROPENE	76.525	135.75	295.80	478.00	47.10	234.0	0.3270	0.277	0.153
149	C3H5Cl	3-CHLOROPROPENE	76.525	138.65	318.11	514.15	47.10	234.0	0.3270	0.258	0.154
150	C3H5ClO	ALPHA-EPICHLOROHYDRIN	92.525	215.95	389.26	610.00	49.00	233.0	0.3971	0.225	0.256
151	C3H5ClO2	METHYL CHLOROACETATE	108.524	241.03	402.97	600.00	45.00	270.0	0.4019	0.244	0.434
152	C3H5ClO2	ETHYL CHLOROFORMATE	108.524	192.00	366.00	508.15	45.00	274.0	0.3961	0.292	0.835
153	C3H5Cl3	1-2-3-TRICHLOROPROPANE	147.431	258.45	430.00	652.00	38.70	334.0	0.4414	0.238	0.306
154	C3H5N	PROPIONITRILE	55.079	180.26	370.50	564.40	41.85	229.0	0.2405	0.204	0.325
155	C3H5NO	ACRYLAMIDE	71.079	357.65	465.75	710.00	57.30	260.0	0.2734	0.252	0.196
156	C3H5NO	HYDRACRYLONITRILE	71.079	227.15	494.15	690.00	48.90	243.0	0.2925	0.207	0.826
157	C3H5NO	LACTONITRILE	71.079	233.00	457.00	643.00	50.30	243.0	0.2925	0.229	0.796
158	C3H5N3O9	NITROGLYCERINE	227.088	286.15	523.00	680.00	30.00	419.0	0.5420	0.222	1.184
159	C3H6	CYCLOPROPANE	42.081	145.73	240.37	397.91	55.75	162.8	0.2585	0.274	0.134
160	C3H6	PROPYLENE	42.081	87.90	225.43	364.76	46.13	181.0	0.2325	0.275	0.142
161	C3H6Cl2	1-1-DICHLOROPROPANE	112.986	---	361.25	560.00	42.40	291.0	0.3883	0.265	0.253
162	C3H6Cl2	1-2-DICHLOROPROPANE	112.986	172.71	369.52	572.00	42.40	291.0	0.3883	0.259	0.251
163	C3H6Cl2	1-3-DICHLOROPROPANE	112.987	173.65	393.55	603.00	41.50	291.0	0.3883	0.241	0.292
164	C3H6O	ACETONE	58.080	178.45	329.44	508.20	47.02	209.0	0.2779	0.233	0.306
165	C3H6O	ALLYL ALCOHOL	58.080	144.15	370.23	545.05	56.20	208.0	0.2792	0.258	0.572
166	C3H6O	METHYL VINYL ETHER	58.080	151.15	278.65	437.00	46.70	210.0	0.2766	0.270	0.237
167	C3H6O	n-PROPIONALDEHYDE	58.080	193.15	321.15	496.00	46.60	210.0	0.2766	0.237	0.302
168	C3H6O	1-2-PROPYLENE OXIDE	58.080	161.22	307.05	482.25	49.24	186.0	0.3123	0.228	0.271
169	C3H6O	1-3-PROPYLENE OXIDE	58.080	---	321.00	520.00	57.50	188.0	0.3089	0.250	0.201
170	C3H6O2	ETHYL FORMATE	74.079	193.55	327.46	508.40	47.42	229.0	0.3235	0.257	0.285
171	C3H6O2	METHYL ACETATE	74.079	175.15	330.09	506.80	46.90	228.0	0.3249	0.254	0.325
172	C3H6O2	PROPIONIC ACID	74.079	252.45	414.32	604.00	45.30	230.0	0.3221	0.207	0.536
173	C3H6O2S	3-MERCAPTOPROPIONIC ACID	106.145	290.65	501.00	729.00	50.20	281.0	0.3777	0.233	0.587
174	C3H6O3	LACTIC ACID	90.079	291.15	447.00	616.00	59.65	216.9	0.4153	0.253	1.035
175	C3H6O3	METHOXYACETIC ACID	90.079	281.00	478.26	691.00	49.80	251.0	0.3589	0.218	0.630
176	C3H6O3	TRIOXANE	90.079	334.65	387.65	604.00	58.20	206.0	0.4373	0.239	0.334
177	C3H7Br	1-BROMOPROPANE	122.993	163.15	344.15	544.00	53.90	266.0	0.4624	0.317	0.285
178	C3H7Br	2-BROMOPROPANE	122.993	184.15	332.56	532.00	55.10	266.0	0.4624	0.331	0.243
179	C3H7Cl	ISOPROPYL CHLORIDE	78.541	155.97	308.85	489.00	45.40	247.0	0.3180	0.276	0.224
180	C3H7Cl	n-PROPYL CHLORIDE	78.541	150.35	319.67	503.15	45.80	247.0	0.3180	0.270	0.228
181	C3H7I	ISOPROPYL IODIDE	169.993	183.15	362.65	578.00	51.20	290.0	0.5862	0.309	0.238
182	C3H7I	n-PROPYL IODIDE	169.993	171.85	375.60	593.00	50.30	290.0	0.5862	0.296	0.258
183	C3H7N	ALLYLAMINE	57.095	184.95	326.45	505.00	51.70	247.0	0.2312	0.304	0.327
184	C3H7N	PROPYLENEIMINE	57.095	229.00	334.00	529.00	54.20	208.0	0.2745	0.256	0.257
185	C3H7NO	N-N-DIMETHYLFORMAMIDE	73.095	212.72	426.15	647.00	44.20	267.0	0.2738	0.219	0.376
186	C3H7NO	N-METHYLACETAMIDE	73.095	301.15	478.15	718.00	49.80	267.0	0.2738	0.223	0.435
187	C3H7NO2	1-NITROPROPANE	89.094	169.16	404.33	605.00	43.50	288.0	0.3094	0.249	0.412
188	C3H7NO2	2-NITROPROPANE	89.094	181.83	393.40	594.00	44.50	288.0	0.3094	0.260	0.376
189	C3H8	PROPANE	44.096	85.46	231.11	369.82	42.49	202.9	0.2174	0.280	0.152
190	C3H8O	ISOPROPANOL	60.096	185.28	355.41	508.31	47.64	220.1	0.2730	0.248	0.669
191	C3H8O	METHYL ETHYL ETHER	60.096	160.00	280.50	437.80	43.98	221.0	0.2719	0.267	0.219
192	C3H8O	n-PROPANOL	60.096	146.95	370.35	536.71	51.70	218.5	0.2750	0.253	0.628
193	C3H8O2	2-METHOXYETHANOL	76.095	188.05	397.55	564.00	50.10	242.0	0.3144	0.259	0.791
194	C3H8O2	METHYLAL	76.095	168.35	315.00	480.60	39.52	213.0	0.3573	0.211	0.230
195	C3H8O2	1-2-PROPYLENE GLYCOL	76.095	213.15	460.75	626.00	61.00	239.0	0.3184	0.280	1.107
196	C3H8O2	1-3-PROPYLENE GLYCOL	76.095	246.45	487.55	658.00	59.20	217.0	0.3507	0.235	1.152
197	C3H8O3	GLYCEROL	92.095	291.33	563.15	723.00	40.00	264.0	0.3488	0.176	1.320
198	C3H8S	n-PROPYLMERCAPTAN	76.163	159.95	340.87	536.00	46.30	254.0	0.2999	0.264	0.235
199	C3H8S	ISOPROPYL MERCAPTAN	76.163	142.61	325.71	517.00	47.50	254.0	0.2999	0.281	0.212
200	C3H9N	n-PROPYLAMINE	59.111	190.15	321.65	496.95	47.42	260.0	0.2274	0.298	0.296
201	C3H9N	ISOPROPYLAMINE	59.111	177.95	305.55	471.85	45.39	221.0	0.2675	0.256	0.279
202	C3H9N	TRIMETHYLAMINE	59.111	156.08	276.02	433.25	40.73	254.0	0.2327	0.287	0.209
203	C3H9NO	1-AMINO-2-PROPANOL	75.111	274.89	432.61	614.00	56.70	278.0	0.2702	0.309	0.794
204	C3H9NO	3-AMINO-1-PROPANOL	75.111	284.15	460.65	649.00	55.00	278.0	0.2702	0.283	0.830
205	C3H9NO	METHYLETHANOLAMINE	75.111	268.65	431.15	630.00	52.20	253.0	0.2969	0.252	0.586
206	C3H9O4P	TRIMETHYL PHOSPHATE	140.076	227.00	465.85	764.00	85.00	---	---	---	---
207	C3H10N2	1-2-PROPANEDIAMINE	74.126	236.53	392.45	587.00	52.70	316.0	0.2346	0.341	0.474
208	C3H10Si	TRIMETHYL SILANE	74.198	137.26	279.85	432.00	31.90	311.0	0.2386	0.276	0.175
209	C4Cl4S	TETRACHLOROTHIOPHENE	221.921	301.97	506.54	753.00	36.70	428.0	0.5185	0.251	0.361

NO	FORMULA	NAME	MW g/mol	T _F K	T _B K	T _C K	P _C bar	V _C cm ³ /mol	ρ _C g/cm ³	Z _C	ω
210	C4Cl6	HEXACHLORO-1-3-BUTADIENE	260.760	252.15	488.15	741.00	28.40	491.0	0.5311	0.226	0.155
211	C4F8	OCTAFLUORO-2-BUTENE	200.031	138.15	270.36	392.00	23.30	347.0	0.5765	0.248	0.291
212	C4F8	OCTAFLUOROCYCLOBUTANE	200.031	232.96	267.17	388.37	27.78	324.8	0.6159	0.279	0.356
213	C4F10	DECAFLUOROBUTANE	238.028	144.95	271.15	386.35	23.23	397.0	0.5996	0.287	0.372
214	C4H2O3	MALEIC ANHYDRIDE	98.058	326.00	475.15	721.00	72.80	219.0	0.4478	0.266	0.546
215	C4H4	VINYLCACETYLENE	52.076	---	278.25	454.00	48.60	205.0	0.2540	0.264	0.118
216	C4H4N2	SUCCINONITRILE	80.089	331.30	540.15	770.00	35.40	300.0	0.2670	0.166	0.559
217	C4H4O	FURAN	68.075	187.55	304.50	490.15	55.02	218.2	0.3120	0.295	0.200
218	C4H4O2	DIKETENE	84.075	266.65	399.20	616.00	59.60	234.0	0.3593	0.272	0.382
219	C4H4O3	SUCCINIC ANHYDRIDE	100.074	393.00	536.58	811.00	67.30	223.0	0.4488	0.223	0.530
220	C4H4O4	FUMARIC ACID	116.073	560.15	563.15	771.00	49.80	297.0	0.3908	0.231	0.989
221	C4H4O4	MALEIC ACID	116.073	403.45	565.00	773.00	49.90	297.0	0.3908	0.231	0.998
222	C4H4S	THIOPHENE	84.142	234.94	357.31	579.35	56.90	219.0	0.3842	0.259	0.193
223	C4H5Cl	CHLOROPRENE	88.536	143.15	332.55	525.00	42.60	273.0	0.3243	0.266	0.193
224	C4H5N	trans-CROTONITRILE	67.090	222.00	394.38	586.00	38.80	282.0	0.2379	0.225	0.398
225	C4H5N	cis-CROTONITRILE	67.090	200.55	380.60	568.00	38.80	265.0	0.2532	0.218	0.379
226	C4H5N	METHACRYLONITRILE	67.090	237.35	363.45	554.00	38.80	265.0	0.2532	0.223	0.301
227	C4H5N	PYRROLE	67.090	249.74	403.00	639.75	62.10	230.0	0.2917	0.269	0.288
228	C4H5N	VINYLCACETONITRILE	67.090	186.15	391.67	584.00	38.80	259.0	0.2590	0.207	0.378
229	C4H5NO2	METHYL CYANOACETATE	99.089	260.08	478.24	687.00	38.10	305.0	0.3249	0.203	0.549
230	C4H6	1-2-BUTADIENE	54.092	136.95	284.00	444.00	45.00	219.0	0.2470	0.267	0.251
231	C4H6	1-3-BUTADIENE	54.092	164.25	268.74	425.37	43.30	220.8	0.2449	0.270	0.193
232	C4H6	DIMETHYLACETYLENE	54.092	240.91	300.13	488.15	50.80	221.0	0.2448	0.277	0.130
233	C4H6	ETHYLACETYLENE	54.092	147.43	281.22	443.20	49.50	222.0	0.2437	0.298	0.247
234	C4H6Cl2	1-3-DICHLORO-trans-2-BUTENE	124.997	---	402.00	618.00	37.80	325.0	0.3846	0.239	0.242
235	C4H6Cl2	1-4-DICHLORO-cis-2-BUTENE	124.997	225.15	425.65	640.00	37.80	343.0	0.3644	0.244	0.331
236	C4H6Cl2	1-4-DICHLORO-trans-2-BUTENE	124.997	274.15	429.26	646.00	37.80	330.0	0.3788	0.232	0.333
237	C4H6Cl2	3-4-DICHLORO-1-BUTENE	124.997	212.00	388.00	589.00	38.50	330.0	0.3788	0.259	0.300
238	C4H6O	trans-CROTONALDEHYDE	70.091	196.65	377.25	571.00	42.50	250.0	0.2804	0.224	0.346
239	C4H6O	2-5-DIHYDROFURAN	70.091	---	339.00	542.00	55.00	216.0	0.3245	0.264	0.229
240	C4H6O	DIVINYL ETHER	70.091	172.05	301.45	463.00	42.50	250.0	0.2804	0.276	0.291
241	C4H6O	METHACROLEIN	70.091	192.15	341.15	530.00	42.50	250.0	0.2804	0.241	0.246
242	C4H6O2	2-BUTYNE-1-4-DIOL	86.090	331.00	511.15	695.00	58.60	256.0	0.3363	0.260	1.134
243	C4H6O2	gamma-BUTYROLACTONE	86.090	229.78	477.15	739.00	59.40	265.0	0.3249	0.256	0.369
244	C4H6O2	cis-CROTONIC ACID	86.090	288.65	445.05	647.00	47.00	270.0	0.3189	0.236	0.572
245	C4H6O2	trans-CROTONIC ACID	86.090	344.55	458.15	666.00	47.00	270.0	0.3189	0.229	0.578
246	C4H6O2	METHACRYLIC ACID	86.090	288.15	434.15	643.00	47.00	270.0	0.3189	0.237	0.468
247	C4H6O2	METHYL ACRYLATE	86.090	196.32	353.35	536.00	42.50	270.0	0.3189	0.258	0.348
248	C4H6O2	VINYL ACETATE	86.090	180.35	345.65	524.00	42.50	270.0	0.3189	0.263	0.338
249	C4H6O3	ACETIC ANHYDRIDE	102.090	200.15	411.78	569.15	46.81	290.0	0.3520	0.287	0.840
250	C4H6O4	SUCCINIC ACID	118.089	461.15	591.00	806.00	47.10	300.0	0.3936	0.211	0.991
251	C4H6O5	DIGLYCOLIC ACID	134.089	421.15	610.00	820.00	44.20	331.0	0.4051	0.215	1.081
252	C4H6O5	MALIC ACID	134.089	403.15	602.00	781.00	50.70	331.0	0.4051	0.258	1.530
253	C4H6O6	TARTARIC ACID	150.088	479.15	660.00	828.00	51.80	305.0	0.4921	0.230	2.011
254	C4H7N	n-BUTYRONITRILE	69.106	161.25	390.75	582.25	37.90	278.0	0.2486	0.218	0.371
255	C4H7N	ISOBUTYRONITRILE	69.106	201.70	376.76	565.00	37.60	278.0	0.2486	0.223	0.338
256	C4H7NO	ACETONE CYANOHYDRIN	85.106	253.15	463.00	647.00	42.50	296.0	0.2875	0.234	0.733
257	C4H7NO	2-METHACRYLAMIDE	85.106	383.65	488.00	741.00	54.50	298.0	0.2856	0.264	0.421
258	C4H7NO	3-METHOXYPROPIONITRILE	85.106	210.12	439.00	638.00	36.30	324.0	0.2627	0.222	0.465
259	C4H7NO	2-PYRROLIDONE	85.106	298.15	518.15	792.00	61.70	264.0	0.3224	0.247	0.434
260	C4H8	1-BUTENE	56.107	87.80	266.90	419.59	40.20	239.9	0.2338	0.276	0.187
261	C4H8	cis-2-BUTENE	56.107	134.26	276.87	435.58	42.06	234.0	0.2398	0.272	0.203
262	C4H8	trans-2-BUTENE	56.107	167.62	274.03	428.63	41.02	238.2	0.2356	0.274	0.218
263	C4H8	CYCLOBUTANE	56.107	182.48	285.66	459.93	49.85	210.2	0.2670	0.274	0.187
264	C4H8	ISOBUTENE	56.107	132.81	266.25	417.90	39.99	238.9	0.2349	0.275	0.189
265	C4H8Cl2	1-4-DICHLOROBUTANE	127.013	235.85	427.05	641.00	36.10	343.0	0.3703	0.232	0.322
266	C4H8O	n-BUTYRALDEHYDE	72.107	176.75	347.95	525.00	40.00	263.0	0.2742	0.241	0.345
267	C4H8O	ISOBUTYRALDEHYDE	72.107	208.15	337.25	507.00	41.00	263.0	0.2742	0.256	0.370
268	C4H8O	1-2-EPOXYBUTANE	72.107	123.15	336.57	526.00	43.90	258.0	0.2795	0.259	0.235
269	C4H8O	METHYL ETHYL KETONE	72.107	186.48	352.79	535.50	41.54	267.0	0.2701	0.249	0.324
270	C4H8O	ETHYL VINYL ETHER	72.107	157.35	308.70	475.15	40.73	263.0	0.2742	0.271	0.266
271	C4H8O	TETRAHYDROFURAN	72.107	164.65	338.00	540.15	51.88	223.9	0.3220	0.259	0.226
272	C4H8O2	cis-2-BUTENE-1-4-DIOL	88.106	284.15	508.15	677.88	52.00	279.0	0.3158	0.257	1.174
273	C4H8O2	trans-2-BUTENE-1-4-DIOL	88.106	300.45	510.00	681.00	52.00	279.0	0.3158	0.256	1.174
274	C4H8O2	ISOBUTYRIC ACID	88.106	227.15	427.85	609.15	40.53	292.0	0.3017	0.234	0.618
275	C4H8O2	n-BUTYRIC ACID	88.106	267.95	436.42	628.00	44.20	283.0	0.3113	0.240	0.604
276	C4H8O2	1-4-DIOXANE	88.106	284.95	374.47	587.00	52.08	238.0	0.3702	0.254	0.280
277	C4H8O2	ETHYL ACETATE	88.106	189.60	350.21	523.30	38.80	286.0	0.3081	0.255	0.366
278	C4H8O2	METHYL PROPIONATE	88.106	185.65	352.60	530.60	40.04	282.0	0.3124	0.256	0.353
279	C4H8O2	n-PROPYL FORMATE	88.106	180.25	353.97	538.00	40.63	285.0	0.3091	0.259	0.318
280	C4H8O2S	SULFOLANE	120.172	300.75	558.15	849.00	50.30	300.0	0.4006	0.214	0.382
281	C4H8S	TETRAHYDROTHIOPHENE	88.173	176.99	394.27	631.95	51.60	249.0	0.3541	0.245	0.199
282	C4H9Br	1-BROMOBUTANE	137.019	160.75	374.75	577.00	45.40	319.0	0.4295	0.302	0.323

NO	FORMULA	NAME	MW g/mol	T _F K	T _B K	T _C K	P _C bar	V _G cm ³ /mol	ρ _C g/cm ³	Z _C	ω
283	C4H9Br	2-BROMOBUTANE	137.019	161.25	364.37	567.00	46.30	320.0	0.4282	0.314	0.268
284	C4H9Cl	n-BUTYL CHLORIDE	92.568	150.05	351.58	537.00	38.20	300.0	0.3086	0.257	0.274
285	C4H9Cl	sec-BUTYL CHLORIDE	92.568	141.85	341.25	520.60	39.00	300.0	0.3086	0.270	0.291
286	C4H9Cl	tert-BUTYL CHLORIDE	92.568	247.75	323.75	507.00	39.00	300.0	0.3086	0.278	0.194
287	C4H9N	PYRROLIDINE	71.122	215.31	359.72	568.55	56.13	248.7	0.2860	0.295	0.275
288	C4H9NO	N-N-DIMETHYLACETAMIDE	87.122	253.15	439.25	658.00	40.30	321.0	0.2714	0.236	0.364
289	C4H9NO	MORPHOLINE	87.122	270.05	401.15	618.00	53.40	276.0	0.3157	0.287	0.358
290	C4H10	n-BUTANE	58.123	134.86	272.65	425.18	37.97	254.9	0.2280	0.274	0.199
291	C4H10	ISOBUTANE	58.123	113.54	261.43	408.14	36.48	262.7	0.2213	0.282	0.177
292	C4H10N2	PIPERAZINE	86.137	379.15	419.15	638.00	55.30	310.0	0.2779	0.323	0.414
293	C4H10O	n-BUTANOL	74.123	183.85	390.81	562.93	44.13	274.5	0.2700	0.259	0.595
294	C4H10O	sec-BUTANOL	74.123	158.45	372.70	536.01	41.94	268.0	0.2766	0.252	0.571
295	C4H10O	tert-BUTANOL	74.123	298.97	355.57	506.20	39.72	275.0	0.2695	0.260	0.616
296	C4H10O	DIETHYL ETHER	74.123	156.85	307.58	466.70	36.38	280.0	0.2647	0.262	0.285
297	C4H10O	METHYL ISOPROPYL ETHER	74.123	127.93	303.92	464.50	38.80	276.0	0.2686	0.277	0.279
298	C4H10O	ISOBUTANOL	74.123	165.15	380.81	547.73	42.95	272.0	0.2725	0.257	0.589
299	C4H10O2	1-3-BUTANEDIOL	90.122	196.15	480.15	643.00	50.00	292.0	0.3086	0.273	1.146
300	C4H10O2	1-4-BUTANEDIOL	90.122	293.05	501.15	667.00	48.80	297.0	0.3034	0.261	1.189
301	C4H10O2	2-3-BUTANEDIOL	90.122	280.75	453.85	611.00	51.30	267.0	0.3375	0.270	1.106
302	C4H10O2	t-BUTYL HYDROPEROXIDE	90.122	277.45	405.50	576.00	43.40	290.0	0.3108	0.263	0.668
303	C4H10O2	1-2-DIMETHOXYETHANE	90.122	215.15	357.20	536.15	38.70	270.6	0.3330	0.235	0.346
304	C4H10O2	2-ETHOXYETHANOL	90.122	---	408.15	569.00	42.40	294.0	0.3065	0.264	0.759
305	C4H10O3	DIETHYLENE GLYCOL	106.122	262.70	518.15	744.60	46.00	312.0	0.3401	0.232	0.621
306	C4H10O4S	DIETHYL SULFATE	154.187	248.00	483.00	792.00	68.90	398.0	0.3874	0.416	0.162
307	C4H10S	n-BUTYL MERCAPTAN	90.189	157.46	371.61	569.00	39.70	307.0	0.2938	0.258	0.278
308	C4H10S	ISOBUTYL MERCAPTAN	90.189	128.31	361.64	559.00	40.60	307.0	0.2938	0.268	0.252
309	C4H10S	sec-BUTYL MERCAPTAN	90.189	133.02	358.13	554.00	40.60	307.0	0.2938	0.271	0.248
310	C4H10S	tert-BUTYL MERCAPTAN	90.189	274.26	337.37	530.00	40.60	307.0	0.2938	0.273	0.191
311	C4H10S	DIETHYL SULFIDE	90.189	169.20	365.25	557.15	39.62	318.0	0.2836	0.272	0.294
312	C4H10S2	DIETHYL DISULFIDE	122.255	171.63	427.13	642.00	38.70	358.0	0.3415	0.260	0.346
313	C4H11N	n-BUTYLAMINE	73.138	224.05	350.55	531.90	42.00	313.0	0.2337	0.297	0.330
314	C4H11N	ISOBUTYLAMINE	73.138	188.55	340.88	513.73	42.15	312.0	0.2344	0.308	0.363
315	C4H11N	sec-BUTYLAMINE	73.138	168.65	336.15	514.30	40.00	310.0	0.2359	0.290	0.282
316	C4H11N	tert-BUTYLAMINE	73.138	206.19	317.55	483.90	38.40	293.0	0.2496	0.280	0.275
317	C4H11N	DIETHYLAMINE	73.138	223.35	328.60	496.60	37.09	301.0	0.2430	0.270	0.304
318	C4H11NO	DIMETHYLETHANOLAMINE	89.137	214.15	407.15	571.82	41.40	300.0	0.2971	0.261	0.711
319	C4H11NO2	DIETHANOLAMINE	105.137	301.15	542.04	715.00	32.70	349.0	0.3013	0.192	1.046
320	C4H11NO2	2-AMINOETHOXYETHANOL	105.137	---	514.00	699.00	43.60	330.0	0.3186	0.248	0.969
321	C4H12N2O	N-AMINOETHYL ETHANOLAMINE	104.152	---	517.00	698.00	44.60	387.0	0.2691	0.297	1.050
322	C4H12Si	TETRAMETHYLSILANE	88.225	174.07	299.80	450.40	28.14	357.0	0.2471	0.268	0.224
323	C4H13N3	DIETHYLENE TRIAMINE	103.167	234.15	480.25	676.00	42.20	342.0	0.3017	0.257	0.700

Appendix E

GAS HEAT CAPACITY FOR C₁ TO C₄ COMPOUNDS

Carl L. Yaws
Lamar University, Beaumont, Texas

			$C_p = A + B T + C T^2 + D T^3 + E T^4$ (C_p - joule/g-mol K, T - K)						
NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
1	CBrClF ₂	BROMOCHLORODIFLUOROMETHANE	18.387	2.7933E-01	-3.7127E-04	2.2889E-07	-5.3229E-11	100	1500
2	CBrCl ₃	BROMOTRICHLOROMETHANE	24.484	3.2024E-01	-4.9096E-04	3.3359E-07	-8.2982E-11	100	1500
3	CBrF ₃	BROMOTRIFLUOROMETHANE	17.208	2.4770E-01	-2.9181E-04	1.6247E-07	-3.4765E-11	100	1500
4	CBr ₂ F ₂	DIBROMODIFLUOROMETHANE	22.399	2.7403E-01	-3.7433E-04	2.3638E-07	-5.6067E-11	100	1500
5	CClF ₃	CHLOROTRIFLUOROMETHANE	13.762	2.4951E-01	-2.8194E-04	1.4962E-07	-3.0450E-11	100	1500
6	CClN	CYANOGEN CHLORIDE	21.270	1.1915E-01	-1.6822E-04	1.1457E-07	-2.9210E-11	100	1500
7	CCl ₂ F ₂	DICHLORODIFLUOROMETHANE	14.877	2.8292E-01	-3.6295E-04	2.1591E-07	-4.8619E-11	100	1500
8	CCl ₂ O	PHOSGENE	20.747	1.7972E-01	-2.3242E-04	1.4224E-07	-3.3087E-11	100	1500
9	CCl ₃ F	TRICHLOROFLUOROMETHANE	16.636	3.1336E-01	-4.4426E-04	2.8612E-07	-6.8556E-11	89	1500
10	CCl ₄	CARBON TETRACHLORIDE	19.816	3.3311E-01	-5.0511E-04	3.4057E-07	-8.4249E-11	100	1500
11	CF ₂ O	CARBONYL FLUORIDE	23.640	8.9853E-02	-2.4575E-05	-2.8140E-08	1.4023E-11	100	1500
12	CF ₄	CARBON TETRAFLUORIDE	15.278	1.9916E-01	-1.6369E-04	5.1686E-08	-3.1820E-12	100	1500
13	CHBr ₃	TRIBROMOMETHANE	33.356	1.7475E-01	-1.9516E-04	1.0725E-07	-2.3180E-11	100	1500
14	CHClF ₂	CHLORODIFLUOROMETHANE	20.519	1.4746E-01	-9.2440E-05	1.4379E-08	3.4356E-12	100	1500
15	CHCl ₂ F	DICHLOROFLUOROMETHANE	33.078	1.0473E-01	-2.2510E-05	-3.8822E-08	1.8245E-11	100	1500
16	CHCl ₃	CHLOROFORM	22.487	1.9823E-01	-2.1676E-04	1.1636E-07	-2.4555E-11	100	1500
17	CHF ₃	TRIFLUOROMETHANE	23.287	9.5385E-02	2.0049E-05	-7.4432E-08	2.7428E-11	100	1500
18	CHN	HYDROGEN CYANIDE	25.766	3.7969E-02	-1.2416E-05	-3.2240E-09	2.2610E-12	100	1500
19	CH ₂ BrCl	BROMOCHLOROMETHANE	27.752	9.1021E-02	-8.2541E-06	-3.7449E-08	1.5156E-11	100	1500
20	CH ₂ Br ₂	DIBROMOMETHANE	28.305	1.0581E-01	-4.7966E-05	-2.6711E-09	5.1497E-12	100	1500
21	CH ₂ Cl ₂	DICHLOROMETHANE	26.694	8.3984E-02	8.9712E-06	-5.0924E-08	1.8726E-11	100	1500
22	CH ₂ F ₂	DIFLUOROMETHANE	30.323	1.1176E-02	1.5809E-04	-1.6323E-07	4.7955E-11	100	1500
23	CH ₂ I ₂	DIIODOMETHANE	28.918	1.1739E-01	-7.3808E-05	1.7055E-08	1.2051E-14	100	1500
24	CH ₂ O	FORMALDEHYDE	34.428	-2.9779E-02	1.5104E-04	-1.2733E-07	3.3887E-11	50	1500
25	CH ₂ O ₂	FORMIC ACID	31.745	7.4234E-03	1.8791E-04	-1.9475E-07	5.7613E-11	50	1500
26	CH ₃ Br	METHYL BROMIDE	29.146	2.4374E-02	1.0655E-04	-1.1324E-07	3.3241E-11	100	1500
27	CH ₃ Cl	METHYL CHLORIDE	27.385	2.6036E-02	1.0320E-04	-1.0887E-07	3.1642E-11	150	1500
28	CH ₃ Cl ₃ Si	METHYL TRICHLOROSILANE	56.670	2.0066E-01	-1.6721E-04	7.2533E-08	-1.2684E-11	200	1500
29	CH ₃ F	METHYL FLUORIDE	34.077	-3.5019E-02	2.2031E-04	-1.9566E-07	5.4104E-11	100	1500
30	CH ₃ I	METHYL IODIDE	25.635	6.6836E-02	1.2292E-05	-3.6742E-08	1.2301E-11	100	1500
31	CH ₃ NO	FORMAMIDE	30.911	1.4363E-02	1.9281E-04	-1.9805E-07	5.8262E-11	150	1500
32	CH ₃ NO ₂	NITROMETHANE	41.136	3.4367E-03	2.6380E-04	-2.6898E-07	7.9503E-11	100	1500
33	CH ₄	METHANE	34.942	-3.9957E-02	1.9184E-04	-1.5303E-07	3.9321E-11	50	1500
34	CH ₄ Cl ₂ Si	METHYL DICHLOROSILANE	37.250	2.3327E-01	-1.9952E-04	9.1473E-08	-1.7387E-11	200	1500
35	CH ₄ O	METHANOL	40.046	-3.8287E-02	2.4529E-04	-2.1679E-07	5.9909E-11	100	1500
36	CH ₄ O ₃ S	METHANESULFONIC ACID	65.450	-1.0363E-01	6.2784E-04	-6.7194E-07	2.3114E-10	298	1000
37	CH ₄ S	METHYL MERCAPTAN	40.307	-3.6753E-03	1.8400E-04	-1.7596E-07	5.0137E-11	100	1500
38	CH ₅ Cl ₃ Si	METHYL CHLOROSILANE	25.886	2.1064E-01	-1.3055E-04	3.6499E-08	-3.0118E-12	200	1500
39	CH ₅ N	METHYLAMINE	40.039	-1.5108E-02	2.5012E-04	-2.3336E-07	6.5582E-11	100	1500
40	CH ₆ Si	METHYL SILANE	25.277	1.2988E-01	5.9803E-05	-1.2080E-07	4.0036E-11	100	1500
41	CN ₄ O ₈	TETRANITROMETHANE	23.733	5.5312E-01	-4.5854E-04	1.5286E-07	-1.3967E-11	298	1500
42	CO	CARBON MONOXIDE	29.556	-6.5807E-03	2.0130E-05	-1.2227E-08	2.2617E-12	60	1500
43	COS	CARBONYL SULFIDE	20.913	9.2794E-02	-9.7014E-05	5.0943E-08	-1.0615E-11	100	1500
44	CO ₂	CARBON DIOXIDE	27.437	4.2315E-02	-1.9555E-05	3.9968E-09	-2.9872E-13	50	5000
45	CS ₂	CARBON DISULFIDE	20.461	1.2299E-01	-1.6184E-04	1.0199E-07	-2.4444E-11	100	1500
46	C ₂ BrF ₃	BROMOTRIFLUOROETHYLENE	33.956	2.3803E-01	-2.5448E-04	1.3108E-07	-2.6462E-11	300	1200
47	C ₂ Br ₂ F ₄	1,2-DIBROMOTETRAFLUOROETHANE	50.542	3.7777E-01	-4.8770E-04	3.1054E-07	-7.8174E-11	298	1200
48	C ₂ ClF ₃	CHLOROTRIFLUOROETHYLENE	28.388	2.5871E-01	-2.9010E-04	1.5876E-07	-3.3880E-11	300	1500
49	C ₂ ClF ₅	CHLOROPENTAFLUOROETHANE	24.663	3.8598E-01	-3.8927E-04	1.7751E-07	-2.9992E-11	200	1500
50	C ₂ Cl ₂ F ₄	1,2-DICHLOROTETRAFLUOROETHANE	17.183	4.8507E-01	-5.9368E-04	3.3494E-07	-7.1705E-11	273	1500
51	C ₂ Cl ₃ F ₃	1,1,2-TRICHLOROTRIFLUOROETHANE	42.456	4.0973E-01	-5.0045E-04	2.8463E-07	-6.1623E-11	200	1500
52	C ₂ Cl ₄	TETRAFLOROETHYLENE	34.627	3.1065E-01	-4.5258E-04	3.2734E-07	-9.4234E-11	298	1000
53	C ₂ Cl ₄ F ₂	1,1,2,2-TETRACHLORODIFLUOROETHANE	3.788	6.9339E-01	-1.0927E-03	7.6080E-07	-1.9434E-10	298	1000
54	C ₂ Cl ₄ O	TRICHLOROACETYL CHLORIDE	55.547	2.5821E-01	-2.9449E-04	1.6054E-07	-3.3869E-11	298	1500
55	C ₂ Cl ₆	HEXACHLOROETHANE	48.475	4.4117E-01	-5.9638E-04	3.6922E-07	-8.5631E-11	150	1500
56	C ₂ F ₄	ETRAFLUROETHYLENE	30.934	2.1587E-01	-1.9110E-04	7.5713E-08	-1.0493E-11	100	1500
57	C ₂ F ₆	HEXAFLUROETHANE	13.604	4.3503E-01	-4.8166E-04	2.4841E-07	-4.8897E-11	100	1500
58	C ₂ HBrClF ₃	HALOTHANE	65.307	1.2411E-01	8.8736E-05	-1.7716E-07	6.3268E-11	100	1500
59	C ₂ HClF ₂	2-CHLORO-1,1-DIFLUOROETHYLENE	19.530	2.4576E-01	-2.5701E-04	1.3429E-07	-2.7612E-11	298	1500
60	C ₂ HCl ₃	TRICHLOROETHYLENE	40.879	1.6218E-01	-1.0399E-04	1.3310E-08	5.9103E-12	100	1500

$$C_p = A + B T + C T^2 + D T^3 + E T^4 \quad (C_p - \text{joule/g-mol K, } T - \text{K})$$

NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
61	C2HCl3O	DICHLOROACETYL CHLORIDE	38.143	2.3343E-01	-1.9070E-04	5.6320E-08	-2.5489E-12	298	1500
62	C2HCl3O	TRICHLOROACETALDEHYDE	46.176	2.3126E-01	-2.3659E-04	1.2539E-07	-2.7197E-11	298	1200
63	C2HCl5	PENTACHLOROETHANE	28.297	4.3657E-01	-5.5684E-04	3.3877E-07	-7.8834E-11	100	1500
64	C2HF3O2	TRIFLUOROACETIC ACID	9.274	3.9410E-01	-4.3755E-04	2.4769E-07	-5.7309E-11	298	1200
65	C2HF5	PENTAFLUOROETHANE	40.370	2.0895E-01	-4.5524E-05	-8.2827E-08	3.9062E-11	100	1500
66	C2H2	ACETYLENE	19.360	1.1519E-01	-1.2374E-04	7.2370E-08	-1.6590E-11	200	1500
67	C2H2Br4	1,1,2,2-TETRABROMOETHANE	49.111	2.5471E-01	-2.1340E-04	7.7534E-08	-9.0356E-12	150	1500
68	C2H2Cl2	1,1-DICHLOROETHYLENE	21.272	2.0394E-01	-1.8292E-04	8.2561E-08	-1.4802E-11	200	1500
69	C2H2Cl2	cis-1,2-DICHLOROETHYLENE	11.376	2.4489E-01	-2.5183E-04	1.3368E-07	-2.8416E-11	200	1500
70	C2H2Cl2	trans-1,2-DICHLOROETHYLENE	19.666	2.0908E-01	-1.9503E-04	9.4941E-08	-1.8848E-11	200	1500
71	C2H2Cl2O	CHLOROACETYL CHLORIDE	29.566	2.1377E-01	-1.8076E-04	7.9913E-08	-1.4782E-11	298	1500
72	C2H2Cl2O	DICHLOROACETALDEHYDE	39.761	1.3843E-01	9.8425E-06	-1.0396E-07	4.4962E-11	298	1200
73	C2H2Cl2O2	DICHLOROACETIC ACID	48.334	1.7165E-01	-6.2134E-05	-3.6029E-08	2.3198E-11	298	1200
74	C2H2Cl3F	1,1,1-TRICHLOROFLUOROETHANE	20.183	3.8754E-01	-4.6141E-04	2.7663E-07	-6.5842E-11	298	1200
75	C2H2Cl4	1,1,1,2-TETRACHLOROETHANE	27.227	3.4932E-01	-3.7793E-04	2.0496E-07	-4.3937E-11	200	1500
76	C2H2Cl4	1,1,2,2-TETRACHLOROETHANE	20.427	3.6839E-01	-4.0365E-04	2.2067E-07	-4.7303E-11	298	1500
77	C2H2F2	1,1-DIFLUOROETHYLENE	24.354	1.2196E-01	1.1084E-05	-7.9704E-08	3.0820E-11	100	1500
78	C2H2F4	1,1,1,2-TETRAFLUOROETHANE	8.429	3.4966E-01	-3.3281E-04	1.5603E-07	-2.8939E-11	200	1500
79	C2H2O	KETENE	-14.704	3.1238E-01	-4.3385E-04	2.9499E-07	-7.5221E-11	200	1500
80	C2H2O4	OXALIC ACID	-5.565	1.3496E-01	1.3737E-05	-1.9105E-07	1.1311E-10	298	1000
81	C2H3Br	VINYL BROMIDE	19.032	1.4697E-01	-7.2736E-05	4.7354E-09	4.4305E-12	200	1500
82	C2H3Cl	VINYL CHLORIDE	17.193	1.4564E-01	-6.4281E-05	-3.2385E-09	6.7882E-12	200	1500
83	C2H3ClF2	1-CHLORO-1,1-DIFLUOROETHANE	20.964	2.6700E-01	-2.0774E-04	7.5759E-08	-9.7753E-12	200	1500
84	C2H3ClO	ACETYL CHLORIDE	37.484	1.0683E-01	1.3035E-05	-5.7327E-08	1.9960E-11	200	1500
85	C2H3ClO	CHLOROACETALDEHYDE	25.272	1.5004E-01	-3.4110E-05	-4.1182E-08	2.0993E-11	298	1200
86	C2H3ClO2	CHLOROACETIC ACID	9.327	2.9997E-01	-2.6947E-04	1.2616E-07	-2.4406E-11	298	1500
87	C2H3ClO2	METHYL CHLOROFORMATE	13.353	2.7827E-01	-2.0298E-04	3.2225E-08	1.9750E-11	298	900
88	C2H3Cl3	1,1,1-TRICHLOROETHANE	18.674	3.3443E-01	-3.4963E-04	1.8764E-07	-4.0744E-11	100	1500
89	C2H3Cl3	1,1,2-TRICHLOROETHANE	28.881	2.4893E-01	-1.7639E-04	5.2632E-08	-3.5668E-12	200	1500
90	C2H3F	VINYL FLUORIDE	27.617	5.4052E-02	1.3093E-04	-1.6220E-07	5.0829E-11	100	1500
91	C2H3F3	1,1,1-TRIFLUOROETHANE	33.444	1.5361E-01	3.3402E-05	-1.1974E-07	4.4424E-11	100	1500
92	C2H3N	ACETONITRILE	36.947	2.2085E-02	1.4661E-04	-1.5012E-07	4.3482E-11	100	1500
93	C2H3NO	METHYL ISOCYANATE	21.328	8.5385E-02	7.8504E-05	-1.0050E-07	2.9508E-11	298	1500
94	C2H4	ETHYLENE	32.083	-1.4831E-02	2.4774E-04	-2.3766E-07	6.8274E-11	60	1500
95	C2H4Br2	1,1-DIBROMOETHANE	21.084	2.5090E-01	-2.0060E-04	8.4960E-08	-1.5026E-11	200	1500
96	C2H4Br2	1,2-DIBROMOETHANE	47.739	1.3553E-01	1.0414E-05	-6.8462E-08	2.5192E-11	200	1500
97	C2H4Cl2	1,1-DICHLOROETHANE	15.730	2.6124E-01	-2.1489E-04	9.5761E-08	-1.8004E-11	200	1500
98	C2H4Cl2	1,2-DICHLOROETHANE	37.275	1.4362E-01	1.0378E-05	-7.8305E-08	2.8872E-11	200	1500
99	C2H4Cl2O	BIS(CHLOROMETHYL) ETHER	3.763	3.6729E-01	-3.5749E-04	1.8325E-07	-3.7910E-11	298	1500
100	C2H4F2	1,1-DIFLUOROETHANE	36.271	7.8276E-02	1.6310E-04	-2.0396E-07	6.3814E-11	100	1500
101	C2H4F2	1,2-DIFLUOROETHANE	18.309	2.0288E-01	-6.1613E-05	-3.8781E-08	2.0688E-11	200	1500
102	C2H4O	ACETALDEHYDE	34.140	4.0020E-02	1.5634E-04	-1.6445E-07	4.7248E-11	100	1500
103	C2H4O	ETHYLENE OXIDE	30.827	-7.6041E-03	3.2347E-04	-3.2747E-07	9.7271E-11	50	1500
104	C2H4O2	ACETIC ACID	34.850	3.7626E-02	2.8311E-04	-3.0767E-07	9.2646E-11	50	1500
105	C2H4O2	METHYL FORMATE	5.795	2.5072E-01	-1.7515E-04	6.0565E-08	-8.1015E-12	250	1500
106	C2H5Br	BROMOETHANE	26.552	1.1837E-01	6.7525E-05	-1.1655E-07	3.7186E-11	100	1500
107	C2H5Cl	ETHYL CHLORIDE	35.946	5.2294E-02	2.0321E-04	-2.2795E-07	6.9123E-11	100	1500
108	C2H5ClO	2-CHLOROETHANOL	12.997	2.5587E-01	-1.6553E-04	5.2292E-08	-6.5812E-12	298	1500
109	C2H5F	ETHYL FLUORIDE	21.452	1.2080E-01	7.8409E-05	-1.2578E-07	3.9184E-11	150	1500
110	C2H5I	ETHYL IODIDE	27.759	1.1915E-01	5.9726E-05	-1.0756E-07	3.4157E-11	100	1500
111	C2H5N	ETHYLENIMINE	12.316	1.1833E-01	1.2598E-04	-1.8322E-07	5.8831E-11	150	1500
112	C2H5NO	ACETAMIDE	17.748	1.3627E-01	1.0668E-04	-1.8647E-07	6.2842E-11	100	1500
113	C2H5NO	N-METHYLFORMAMIDE	43.449	-1.0054E-01	7.2412E-04	-8.6224E-07	3.2724E-10	298	1000
114	C2H5NO2	NITROETHANE	17.726	2.2334E-01	-2.1690E-05	-8.0889E-08	3.2223E-11	200	1500
115	C2H6	ETHANE	28.146	4.3447E-02	1.8946E-04	-1.9082E-07	5.3349E-11	100	1500
116	C2H6AlCl	DIMETHYLALUMINUM CHLORIDE	13.870	3.1526E-01	-2.4008E-04	9.9159E-08	-1.7228E-11	298	1500
117	C2H6O	DIMETHYL ETHER	34.668	7.0293E-02	1.6530E-04	-1.7675E-07	4.9313E-11	100	1500
118	C2H6O	ETHANOL	27.091	1.1055E-01	1.0957E-04	-1.5046E-07	4.6601E-11	100	1500
119	C2H6OS	DIMETHYL SULFOXIDE	27.816	2.4839E-01	-1.3176E-04	2.3843E-08	1.6501E-12	200	1500
120	C2H6O2	ETHYLENE GLYCOL	48.218	1.9073E-01	-6.6117E-05	-1.8834E-08	1.2555E-11	200	1500
121	C2H6O4S	DIMETHYL SULFATE	23.800	3.7920E-01	-2.0385E-04	2.4893E-08	1.594E-12	200	1500
122	C2H6S	DIMETHYL SULFIDE	35.994	1.2381E-01	5.0871E-05	-9.1708E-08	2.8274E-11	200	1500
123	C2H6S	ETHYL MERCAPTAN	47.034	4.1940E-02	2.3486E-04	-2.5035E-07	7.4049E-11	100	1500
124	C2H6S2	DIMETHYL DISULFIDE	50.010	1.4793E-01	4.2325E-05	-9.9087E-08	3.2173E-11	200	1500
125	C2H7N	DIMETHYLAMINE	30.638	1.0737E-01	1.5824E-04	-1.9418E-07	5.8509E-11	200	1500
126	C2H7N	ETHYLAMINE	30.983	1.2458E-01	1.0966E-04	-1.5256E-07	4.6640E-11	200	1500
127	C2H7NO	MONOETHANOLAMINE	-0.555	3.7003E-01	-3.1976E-04	1.5834E-07	-3.2344E-11	298	1500
128	C2H8N2	ETHYLENEDIAMINE	10.429	3.2490E-01	-1.9912E-04	6.3557E-08	-8.7124E-12	298	1500
129	C2H8Si	DIMETHYL SILANE	27.940	2.2419E-01	-4.0022E-06	-9.9567E-08	3.6936E-11	100	1500
130	C2N2	CYANOGEN	22.445	1.6837E-01	-2.3212E-04	1.5784E-07	-4.0479E-11	100	1500
131	C3F6	HEXAFLUOROPROPYLENE	-3.108	5.2270E-01	-4.6521E-04	1.9228E-07	-2.9928E-11	200	1500
132	C3F6O	HEXAFLUOROACETONE	0.451	5.2201E-01	-4.5370E-04	1.6725E-07	-1.9476E-11	200	1500

$$C_p = A + B T + C T^2 + D T^3 + E T^4 \quad (C_p - \text{joule/g-mol K, } T - \text{K})$$

NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
133	C3F8	OCTAFLUOROPROPANE	14.695	6.1745E-01	-6.7174E-04	3.4675E-07	-6.9257E-11	273	1500
134	C3H2N2	MALONONITRILE	27.389	1.6397E-01	-3.8642E-05	-5.4165E-08	2.7216E-11	298	1200
135	C3H3Cl	PROPARGYL CHLORIDE	20.366	2.2487E-01	-1.9722E-04	9.5424E-08	-1.9480E-11	298	1500
136	C3H3N	ACRYLONITRILE	18.425	1.8336E-01	-1.0072E-04	1.8747E-08	9.1114E-13	200	1500
137	C3H3NO	OXAZOLE	25.962	5.5802E-02	3.1816E-04	-3.7323E-07	1.1787E-10	50	1500
138	C3H4	METHYLACETYLENE	27.565	1.2037E-01	-6.0666E-06	-4.0713E-08	1.5078E-11	200	1500
139	C3H4	PROPADIENE	28.504	8.1576E-02	1.0896E-04	-1.4641E-07	4.5759E-11	50	1500
140	C3H4Cl2	2,3-DICHLOROPROPENE	29.854	2.6319E-01	-2.1492E-04	9.6796E-08	-1.8613E-11	298	1200
141	C3H4O	ACROLEIN	109.243	-5.0952E-01	1.7059E-03	-1.8068E-06	6.5983E-10	298	1000
142	C3H4O	PROPARGYL ALCOHOL	20.577	2.0827E-01	-1.1794E-04	2.3926E-08	1.9047E-13	298	1500
143	C3H4O2	ACRYLIC ACID	7.755	2.9386E-01	-2.0878E-04	7.1591E-08	-9.0960E-12	250	1500
144	C3H4O2	BETA-PROPIOLACTONE	9.108	2.3694E-01	-5.7117E-05	-5.5709E-08	2.6215E-11	200	1500
145	C3H4O2	VINYL FORMATE	-19.250	4.1753E-01	-4.2109E-04	2.2583E-07	-4.7796E-11	298	1500
146	C3H4O3	ETHYLENE CARBONATE	---	---	---	---	---	---	---
147	C3H4O3	PYRUVIC ACID	5.045	3.7767E-01	-3.4222E-04	1.6758E-07	-3.3836E-11	298	1500
148	C3H5Cl	2-CHLOROPROPENE	33.157	1.7339E-01	-4.0298E-05	-3.2447E-08	1.4113E-11	298	1500
149	C3H5Cl	3-CHLOROPROPENE	24.507	1.8758E-01	-2.1732E-05	-6.0427E-08	2.4116E-11	200	1500
150	C3H5ClO	alpha-EPOCHLOROHYDRIN	-27.780	5.1614E-01	-5.6307E-04	3.2430E-07	-7.2399E-11	298	1500
151	C3H5ClO2	METHYL CHLOROACETATE	-13.590	5.2003E-01	-5.7146E-04	3.3108E-07	-7.4031E-11	298	1500
152	C3H5ClO2	ETHYL CHLOROFORMATE	32.231	2.5311E-01	-6.0013E-05	-5.0872E-08	2.2667E-11	100	1500
153	C3H5Cl3	1,2,3-TRICHLOROPROPANE	45.369	2.7047E-01	-1.3637E-04	1.1641E-08	7.2782E-12	200	1500
154	C3H5N	PROPIONITRILE	17.618	2.2119E-01	-1.0707E-04	1.7352E-08	1.0610E-12	200	1500
155	C3H5NO	ACRYLAMIDE	13.165	2.6213E-01	-8.5250E-05	-3.5101E-08	2.0435E-11	200	1500
156	C3H5NO	HYDRACRYLONITRILE	8.904	3.1056E-01	-2.0843E-04	6.3273E-08	-6.1415E-12	298	1500
157	C3H5NO	LACTONITRILE	30.071	2.3651E-01	-1.0389E-04	1.4435E-08	1.2163E-12	298	1500
158	C3H5N3O9	NITROGLYCERINE	---	---	---	---	---	---	---
159	C3H6	CYCLOPROPANE	21.172	6.3106E-02	2.9197E-04	-3.2708E-07	9.9730E-11	100	1500
160	C3H6	PROPYLENE	31.298	7.2449E-02	1.9481E-04	-2.1582E-07	6.2974E-11	90	1500
161	C3H6Cl2	1,1-DICHLOROPROPANE	36.554	2.2898E-01	-2.1999E-05	-8.4949E-08	3.4171E-11	150	1500
162	C3H6Cl2	1,2-DICHLOROPROPANE	34.575	2.4270E-01	-5.7726E-05	-4.9517E-08	2.3275E-11	200	1500
163	C3H6Cl2	1,3-DICHLOROPROPANE	37.917	2.3441E-01	-5.7287E-05	-4.5766E-08	2.1530E-11	200	1500
164	C3H6O	ACETONE	35.918	9.3896E-02	1.8730E-04	-2.1643E-07	6.3174E-11	100	1500
165	C3H6O	ALLYL ALCOHOL	18.528	2.1287E-01	-2.8839E-05	-6.5014E-08	2.6352E-11	200	1500
166	C3H6O	METHYL VINYL ETHER	15.321	2.3596E-01	-9.9256E-05	7.6893E-09	3.3293E-12	298	1500
167	C3H6O	n-PROPIONALDEHYDE	58.911	4.8385E-03	3.3514E-04	-3.0509E-07	8.3305E-11	200	1500
168	C3H6O	1,2-PROPYLENE OXIDE	29.501	9.2545E-02	2.5626E-04	-2.9921E-07	9.0294E-11	50	1500
169	C3H6O	1,3-PROPYLENE OXIDE	-32.684	4.0929E-01	-3.6377E-04	2.0140E-07	-4.5037E-11	298	1500
170	C3H6O2	ETHYL FORMATE	36.654	1.4922E-01	1.3957E-04	-1.9500E-07	5.9055E-11	100	1500
171	C3H6O2	METHYL ACETATE	-22.287	4.8275E-01	-4.6631E-04	2.3286E-07	-4.3094E-11	298	1200
172	C3H6O2	PROPIONIC ACID	-0.970	3.8307E-01	-3.0872E-04	1.3886E-07	-2.6720E-11	298	1500
173	C3H6O2S	3-MERCAPTOPROPIONIC ACID	26.577	3.7025E-01	-2.9565E-04	1.5526E-07	-4.2314E-11	298	1200
174	C3H6O3	LACTIC ACID	4.890	4.2659E-01	-3.5416E-04	1.5688E-07	-2.9209E-11	298	1500
175	C3H6O3	METHOXYACETIC ACID	-42.782	7.8675E-01	-1.3648E-03	1.3336E-06	-5.0983E-10	298	900
176	C3H6O3	TRIOXANE	4.910	2.6407E-01	6.9003E-05	-1.9208E-07	6.6054E-11	200	1500
177	C3H7Br	1-BROMOPROPANE	24.209	2.2956E-01	-2.9974E-05	-6.7459E-08	2.6960E-11	200	1500
178	C3H7Br	2-BROMOPROPANE	28.602	2.1902E-01	-4.6160E-06	-9.1820E-08	3.4572E-11	200	1500
179	C3H7Cl	ISOPROPYL CHLORIDE	45.660	5.9543E-02	2.4116E-04	-2.8322E-07	8.6109E-11	100	1500
180	C3H7Cl	n-PROPYL CHLORIDE	16.153	2.6543E-01	-9.2380E-05	-1.9679E-08	1.4135E-11	200	1500
181	C3H7I	ISOPROPYL IODIDE	29.083	2.2383E-01	-1.7102E-05	-8.1396E-08	3.1643E-11	200	1500
182	C3H7I	n-PROPYL IODIDE	17.653	2.7777E-01	-1.1961E-04	-7.5057E-10	9.3394E-12	200	1500
183	C3H7N	ALLYLAMINE	18.274	2.6583E-01	-1.2102E-04	1.3458E-08	3.2317E-12	298	1500
184	C3H7N	PROPYLENEIMINE	-38.561	4.9894E-01	-4.5377E-04	2.2334E-07	-4.4943E-11	298	1500
185	C3H7NO	N,N-DIMETHYLFORMAMIDE	29.310	2.0837E-01	1.0912E-04	-2.1506E-07	7.2177E-11	200	1500
186	C3H7NO	N-METHYLACETAMIDE	-1.339	2.8413E-01	-7.2490E-05	-3.9834E-08	1.8761E-11	298	1500
187	C3H7NO2	1-NITROPROPANE	28.505	2.6062E-01	2.4779E-05	-1.4204E-07	5.0913E-11	200	1500
188	C3H7NO2	2-NITROPROPANE	18.837	3.1000E-01	-5.2946E-05	-9.1409E-08	3.8968E-11	200	1500
189	C3H8	PROPANE	28.277	1.1600E-01	1.9597E-04	-2.3271E-07	6.8669E-11	100	1500
190	C3H8O	ISOPROPANOL	25.535	2.1203E-01	5.3492E-05	-1.4727E-07	4.9406E-11	100	1500
191	C3H8O	METHYL ETHYL ETHER	35.289	1.7427E-01	9.4277E-05	-1.4826E-07	4.3296E-11	100	1500
192	C3H8O	n-PROPANOL	31.507	2.3082E-01	-7.8983E-05	6.3696E-09	8.6908E-13	100	2980
193	C3H8O2	2-METHOXYETHANOL	11.416	3.4693E-01	-1.7874E-04	3.1146E-08	1.1718E-12	298	1500
194	C3H8O2	METHYLAL	39.490	2.4609E-02	7.8528E-04	-1.0921E-06	4.5093E-10	298	1000
195	C3H8O2	1,2-PROPYLENE GLYCOL	14.404	3.2565E-01	-7.8741E-05	-1.2420E-07	7.4776E-11	298	1000
196	C3H8O2	1,3-PROPYLENE GLYCOL	7.340	3.5920E-01	-1.5544E-04	-4.8543E-08	4.6374E-11	298	1200
197	C3H8O3	GLYCEROL	9.656	4.2826E-01	-2.6797E-04	3.1794E-08	7.7745E-11	298	1200
198	C3H8S	n-PROPYLMERCAPTAN	37.035	1.9064E-01	7.2562E-05	-1.4440E-07	4.6182E-11	200	1500
199	C3H8S	ISOPROPYL MERCAPTAN	31.652	2.2715E-01	1.2837E-05	-1.0474E-07	3.6662E-11	200	1500
200	C3H9N	n-PROPYLAMINE	7.637	3.3741E-01	-1.6070E-04	2.3836E-08	2.3647E-12	298	1500
201	C3H9N	ISOPROPYLAMINE	-4.758	4.0947E-01	-2.8998E-04	1.1548E-07	-2.0187E-11	298	1500
202	C3H9N	TRIMETHYLAMINE	26.377	2.1496E-01	1.0135E-04	-1.8839E-07	5.9860E-11	200	1500
203	C3H9NO	1-AMINO-2-PROPANOL	-8.396	5.1026E-01	-4.5822E-04	2.3361E-07	-4.9093E-11	298	1500
204	C3H9NO	3-AMINO-1-PROPANOL	7.276	4.0342E-01	-2.5533E-04	8.2617E-08	-1.1842E-11	298	1500

			$C_p = A + B T + C T^2 + D T^3 + E T^4$ (C_p - joule/g-mol K, T - K)						
NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
205	C3H9NO	METHYLETHANOLAMINE	-10.405	4.7860E-01	-3.7360E-04	1.6992E-07	-3.5477E-11	298	1200
206	C3H9O4P	TRIMETHYL PHOSPHATE							
207	C3H10N2	1,2-PROPANEDIAMINE	3.612	4.5467E-01	-3.0830E-04	1.1190E-07	-1.7969E-11	298	1500
208	C3H10Si	TRIMETHYL SILANE	95.333	-3.8565E-02	4.8559E-04	-4.2881E-07	1.1555E-10	298	1500
209	C4Cl4S	TETRACHLOROTHIOPHENE	11.496	5.2672E-01	-6.0693E-04	3.2882E-07	-6.8095E-11	298	1500
210	C4Cl6	HEXACHLORO-1,3-BUTADIENE	101.108	2.8291E-01	-3.0609E-04	1.5800E-07	-3.1695E-11	298	1500
211	C4F8	OCTAFLUORO-2-BUTENE	-17.951	5.6720E-01	-7.4536E-04	4.9173E-07	-1.3124E-10	298	1000
212	C4F8	OCTAFLUOROCYCLOBUTANE	45.579	4.9467E-01	-4.0808E-04	1.3789E-07	-1.1769E-11	200	1500
213	C4F10	DECAFLUOROBUTANE	38.645	6.1357E-01	-3.5155E-04	-1.2037E-07	1.2661E-10	298	1000
214	C4H2O3	MALEIC ANHYDRIDE	-72.015	1.0423E+00	-1.8716E-03	1.6527E-06	-5.5647E-10	298	1000
215	C4H4	VINYLAETHYLENE	19.335	2.2308E-01	-1.3739E-04	3.5667E-08	-1.7996E-12	200	1500
216	C4H4N2	SUCCINONITRILE	15.172	3.2583E-01	-2.2170E-04	5.1492E-08	7.0991E-12	298	1200
217	C4H4O	FURAN	-13.779	3.3489E-01	-2.2273E-04	6.9360E-08	-8.1619E-12	200	2980
218	C4H4O2	DIKETENE	14.704	2.8851E-01	-1.3307E-04	-3.2283E-09	1.3066E-11	298	1200
219	C4H8O3	SUCCINIC ANHYDRIDE	5.950	5.3900E-01	-7.4225E-04	6.0553E-07	-2.0505E-10	298	1000
220	C4H4O4	FUMARIC ACID	15.759	5.9932E-01	-7.0854E-04	4.2980E-07	-1.0058E-10	298	1500
221	C4H4O4	MALEIC ACID	-15.115	5.8902E-01	-6.4675E-04	3.6810E-07	-8.0001E-11	298	1500
222	C4H4S	THIOPHENE	22.037	1.2481E-01	2.4505E-04	-3.3887E-07	1.1175E-10	50	1500
223	C4H5Cl	CHLOROPRENE	20.268	3.1369E-01	-2.4207E-04	9.3958E-08	-1.5001E-11	298	1500
224	C4H5N	trans-CROTONITRILE	-1.466	3.4012E-01	-2.3532E-04	7.3984E-08	-8.2896E-12	250	1500
225	C4H5N	cis-CROTONITRILE	-1.780	3.2415E-01	-2.0418E-04	5.2998E-08	-3.0376E-12	298	1500
226	C4H5N	METHACRYLONITRILE	27.067	2.4619E-01	-1.0446E-04	-2.9851E-10	7.0951E-12	298	1600
227	C4H5N	PYRROLE	-7.680	3.1201E-01	-1.1806E-04	-2.7912E-08	2.1314E-11	200	1500
228	C4H5N	VINYLAETHYLENITRILE	21.519	2.5405E-01	-1.2044E-04	1.1212E-08	4.5239E-12	298	1500
229	C4H5NO2	METHYL CYANOACETATE	-29.108	6.1090E-01	-6.3826E-04	3.0816E-07	-4.1498E-11	298	1200
230	C4H6	1,2-BUTADIENE	30.240	1.5688E-01	6.7668E-05	-1.2597E-07	3.9234E-11	100	1500
231	C4H6	1,3-BUTADIENE	18.835	2.0473E-01	6.2485E-05	-1.7148E-07	6.0858E-11	100	1500
232	C4H6	DIMETHYLAETHYLENE	41.071	1.0010E-01	1.4966E-04	-1.7838E-07	5.2575E-11	200	1500
233	C4H6	ETHYLAETHYLENE	29.857	1.8734E-01	-7.0968E-06	-6.8287E-08	2.5343E-11	200	1500
234	C4H6Cl2	1,3-DICHLORO-trans-2-BUTENE	33.873	3.2586E-01	-2.1702E-04	7.3722E-08	-1.0497E-11	298	1500
235	C4H6Cl2	1,4-DICHLORO-cis-2-BUTENE	0.724	5.0324E-01	-4.5246E-04	2.3322E-07	-5.1035E-11	298	1200
236	C4H6Cl2	1,4-DICHLORO-trans-2-BUTENE	7.205	4.3947E-01	-3.8703E-04	1.8893E-07	-3.8658E-11	298	1500
237	C4H6Cl2	3,4-DICHLORO-1-BUTENE	50.561	2.2753E-01	-4.3374E-05	-1.6965E-08	-4.1852E-12	298	1000
238	C4H6O	trans-CROTONALDEHYDE	11.591	3.2301E-01	-1.3067E-04	1.0791E-08	3.1192E-12	298	1500
239	C4H6O	2,5-DIHYDROFURAN	-11.125	3.4203E-01	-1.4489E-04	-1.3031E-08	1.7017E-11	200	1500
240	C4H6O	DIVINYL ETHER	1.254	3.5057E-01	-2.4183E-04	8.7375E-08	-1.3414E-11	298	1500
241	C4H6O	METHACROLEIN	14.506	1.5922E-01	3.1118E-04	-4.2100E-07	1.4222E-10	298	1200
242	C4H6O2	2-BUTYNE-1,4-DIOL	27.892	3.0363E-01	-1.5388E-04	1.4828E-08	8.3391E-12	298	1200
243	C4H6O2	gamma-BUTYROLACTONE	22.370	1.7297E-01	2.4826E-04	-3.3530E-07	1.0555E-10	100	1500
244	C4H6O2	cis-CROTONIC ACID	0.446	4.7569E-01	-4.4446E-04	2.3234E-07	-5.0122E-11	298	1500
245	C4H6O2	trans-CROTONIC ACID	-5.229	4.5048E-01	-3.8771E-04	1.8280E-07	-5.5647E-11	298	1500
246	C4H6O2	METHACRYLIC ACID	-28.131	5.4744E-01	-5.3877E-04	2.8583E-07	-6.0864E-11	298	1200
247	C4H6O2	METHYL ACRYLATE	1.222	4.0619E-01	-2.8529E-04	9.7153E-08	-1.4073E-11	298	1200
248	C4H6O2	VINYL ACETATE	27.664	2.3366E-01	6.2106E-05	-1.6972E-07	5.7917E-11	100	1500
249	C4H6O3	ACETIC ANHYDRIDE	9.500	3.4425E-01	-8.6736E-05	-7.6769E-08	3.6721E-11	200	1500
250	C4H6O4	SUCCINIC ACID	23.417	4.7462E-01	-3.9265E-04	1.7354E-07	-3.2804E-11	298	1500
251	C4H6O5	DIGLYCOLIC ACID	0.721	6.0311E-01	-5.4772E-04	2.6192E-07	-5.2115E-11	298	1500
252	C4H6O5	MALIC ACID	13.117	5.8833E-01	-5.5236E-04	2.7180E-07	-5.5122E-11	298	1500
253	C4H6O6	TARTARIC ACID	4.526	6.8876E-01	-6.8590E-04	3.5082E-07	-7.2249E-11	298	1500
254	C4H7N	n-BUTYRONITRILE	14.849	3.4077E-01	-2.0780E-04	6.2989E-08	-7.5521E-12	200	1500
255	C4H7N	ISOBUTYRONITRILE	29.844	2.3992E-01	-5.0570E-06	-9.7993E-08	3.6314E-11	200	1500
256	C4H7NO	ACETONE CYANOHYDRIN	14.424	4.1722E-01	-3.1414E-04	1.2671E-07	-2.1994E-11	298	1500
257	C4H7NO	2-METHACRYLAMIDE	-18.333	5.8643E-01	-6.4763E-04	4.4441E-07	-1.2776E-10	298	1200
258	C4H7NO	3-METHOXYPROPIONITRILE	9.316	3.9156E-01	-2.3090E-04	5.4563E-08	-2.5331E-12	298	1500
259	C4H7NO	2-PYRROLIDONE	14.880	2.0967E-01	2.3448E-04	-3.3759E-07	1.0745E-10	100	1500
260	C4H8	1-BUTENE	24.915	2.0648E-01	5.9828E-05	-1.4166E-07	4.7053E-11	200	1500
261	C4H8	cis-2-BUTENE	29.137	1.4008E-01	1.9109E-04	-2.3717E-07	7.0962E-11	200	1500
262	C4H8	trans-2-BUTENE	40.312	1.3472E-01	1.6877E-04	-2.1140E-07	6.3263E-11	200	1500
263	C4H8	CYCLOBUTANE	22.621	8.8506E-02	3.9106E-04	-4.3201E-07	1.2970E-10	100	1500
264	C4H8	ISOBUTENE	32.918	1.8546E-01	7.7876E-05	-1.4645E-07	4.6867E-11	200	1500
265	C4H8Cl2	1,4-DICHLOROBUTANE	0.074	5.1333E-01	-4.3439E-04	2.0527E-07	-4.1398E-11	298	1500
266	C4H8O	n-BUTYRALDEHYDE	64.374	6.4776E-02	3.5143E-04	-3.5371E-07	1.0082E-10	200	1500
267	C4H8O	ISOBUTYRALDEHYDE	-1.360	4.0519E-01	-2.5176E-04	6.0505E-08	6.4389E-12	298	1200
268	C4H8O	1,2-EPOXYBUTANE	6.590	3.4252E-01	-1.2004E-04	-3.3075E-08	2.1868E-11	200	1500
269	C4H8O	METHYL ETHYL KETONE	37.369	2.3045E-01	5.7387E-06	-8.8168E-08	2.9637E-11	200	1500
270	C4H8O	ETHYL VINYL ETHER	-0.946	4.0720E-01	-2.8730E-04	1.1776E-07	-2.1862E-11	298	1500
271	C4H8O	TETRAHYDROFURAN	32.887	2.4554E-02	6.0226E-04	-6.2385E-07	1.8528E-10	50	1500
272	C4H8O2	cis-2-BUTENE-1,4-DIOL	0.759	4.0598E-01	-2.1465E-04	4.8876E-08	-9.9659E-12	298	1000
273	C4H8O2	trans-2-BUTENE-1,4-DIOL	10.706	4.0048E-01	-2.5577E-04	1.1699E-07	-3.9430E-11	298	1000
274	C4H8O2	ISOBUTYRIC ACID	-32.990	5.9238E-01	-5.0629E-04	2.0791E-07	-2.4372E-11	298	1000
275	C4H8O2	n-BUTYRIC ACID	14.368	3.9591E-01	-1.8906E-04	-7.6462E-09	2.0812E-11	298	1200
276	C4H8O2	1,4-DIOXANE	-46.223	5.7263E-01	-3.8800E-04	1.1392E-07	-9.0669E-12	298	1500

			$C_p = A + B T + C T^2 + D T^3 + E T^4$ (C_p - joule/g-mol K, T - K)						
NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
277	C4H8O2	ETHYL ACETATE	69.848	8.2338E-02	3.7159E-04	-4.1129E-07	1.2369E-10	200	1500
278	C4H8O2	METHYL PROPIONATE	-131.953	1.3767E+00	-2.4790E-03	2.2378E-06	-7.6784E-10	298	1000
279	C4H8O2	n-PROPYL FORMATE	-23.921	5.9124E-01	-5.6041E-04	2.9107E-07	-6.1164E-11	298	1500
280	C4H8O2S	SULFOLANE	2.498	4.2069E-01	-9.2595E-05	-1.1878E-07	5.2922E-11	298	1500
281	C4H8S	TETRAHYDROTHIOPHENE	-6.161	3.7746E-01	-1.3544E-04	-3.9013E-08	2.5996E-11	200	1500
282	C4H9Br	1-BROMOBUTANE	29.412	2.9219E-01	-2.6578E-05	-9.7812E-08	3.7812E-11	200	1500
283	C4H9Br	2-BROMOBUTANE	-2.986	4.7747E-01	-3.5869E-04	1.4697E-07	-2.5768E-11	298	1500
284	C4H9Cl	n-BUTYL CHLORIDE	42.595	2.0225E-01	1.5618E-04	-2.4192E-07	7.7385E-11	150	1500
285	C4H9Cl	sec-BUTYL CHLORIDE	41.573	2.1551E-01	1.3137E-04	-2.2399E-07	7.2509E-11	150	1500
286	C4H9Cl	tert-BUTYL CHLORIDE	18.882	3.8038E-01	-1.9282E-04	2.7361E-08	5.0124E-12	200	1500
287	C4H9N	PYRROLIDINE	-8.802	3.1151E-01	6.6087E-05	-2.0528E-07	7.1304E-11	200	1500
288	C4H9NO	N,N-DIMETHYLACETAMIDE	-21.561	5.5114E-01	-4.1728E-04	1.8505E-07	-3.6554E-11	298	1500
289	C4H9NO	MORPHOLINE	-35.984	6.7041E-01	-6.1690E-04	3.0813E-07	-6.3936E-11	298	1500
290	C4H10	n-BUTANE	20.056	2.8153E-01	-1.3143E-05	-9.4571E-08	3.4149E-11	200	1500
291	C4H10	ISOBUTANE	6.772	3.4147E-01	-1.0271E-04	-3.6849E-08	2.0429E-11	200	1500
292	C4H10N2	PIPERAZINE	-64.055	7.9174E-01	-6.6296E-04	2.4423E-07	-3.0828E-11	298	1500
293	C4H10O	n-BUTANOL	8.157	4.1032E-01	-2.2645E-04	6.0372E-08	-6.2802E-12	200	2980
294	C4H10O	sec-BUTANOL	22.465	3.5134E-01	-1.2858E-04	-1.1931E-08	1.2940E-11	200	1500
295	C4H10O	tert-BUTANOL	8.866	4.2394E-01	-2.4206E-04	6.1419E-08	-4.3829E-12	200	1500
296	C4H10O	DIETHYL ETHER	35.979	2.8444E-01	-1.2673E-06	-1.0128E-07	3.4529E-11	200	1500
297	C4H10O	METHYL ISOPROPYL ETHER	48.135	1.8178E-01	2.0299E-04	-2.6456E-07	7.9645E-11	200	1500
298	C4H10O	ISOBUTANOL	71.169	-3.9114E-01	3.1468E-03	-5.6342E-06	3.3290E-09	200	700
299	C4H10O2	1,3-BUTANEDIOL	1.100	5.2567E-01	-4.0675E-04	1.7268E-07	-3.0418E-11	298	1500
300	C4H10O2	1,4-BUTANEDIOL	-7.265	5.5344E-01	-4.5299E-04	2.0616E-07	-3.8161E-11	298	1500
301	C4H10O2	2,3-BUTANEDIOL	-1.698	5.3981E-01	-3.9103E-04	1.2195E-07	-3.1009E-12	298	1200
302	C4H10O2	t-BUTYL HYDROPEROXIDE	2.100	5.5655E-01	-4.5845E-04	2.1168E-07	-4.2051E-11	298	1500
303	C4H10O2	1,2-DIMETHOXYETHANE	6.542	4.6066E-01	-2.6242E-04	6.5670E-08	-5.4689E-12	298	1500
304	C4H10O2	2-ETHOXYETHANOL	-0.213	4.8872E-01	-3.0001E-04	8.1972E-08	-7.4878E-12	298	1500
305	C4H10O3	DIETHYLENE GLYCOL	13.906	4.8367E-01	-2.7706E-04	6.2086E-08	-1.5319E-12	200	1500
306	C4H10O4S	DIETHYL SULFATE	-16.764	6.7731E-01	-6.1231E-04	2.9140E-07	-5.6686E-11	298	1500
307	C4H10S	n-BUTYL MERCAPTAN	46.393	2.2674E-01	1.2687E-04	-1.9438E-07	5.8247E-11	200	1500
308	C4H10S	ISOBUTYL MERCAPTAN	37.177	2.8839E-01	1.8512E-05	-1.3850E-07	4.8919E-11	200	1500
309	C4H10S	sec-BUTYL MERCAPTAN	41.398	2.6634E-01	5.7961E-05	-1.6133E-07	5.3327E-11	200	1500
310	C4H10S	tert-BUTYL MERCAPTAN	30.326	3.3585E-01	-5.0433E-05	-9.9820E-08	4.0942E-11	200	1500
311	C4H10S	DIETHYL SULFIDE	49.361	2.0829E-01	1.5828E-04	-2.2475E-07	6.8109E-11	200	1500
312	C4H10S2	DIETHYL DISULFIDE	50.958	3.3793E-01	-6.5255E-05	-8.3102E-08	3.5651E-11	200	1500
313	C4H11N	n-BUTYLAMINE	45.381	2.2649E-01	1.5750E-04	-2.4190E-07	7.5475E-11	200	1500
314	C4H11N	ISOBUTYLAMINE	-1.698	4.7082E-01	-2.7368E-04	7.1498E-08	-5.8916E-12	298	1500
315	C4H11N	sec-BUTYLAMINE	18.784	3.5654E-01	-4.1983E-05	-1.1648E-07	4.5681E-11	200	1500
316	C4H11N	tert-BUTYLAMINE	28.406	3.3042E-01	4.8961E-06	-1.5250E-07	5.6636E-11	200	1500
317	C4H11N	DIETHYLAMINE	40.851	2.3495E-01	1.6164E-04	-2.5266E-07	7.9398E-11	200	1500
318	C4H11NO	DIMETHYLETHANOLAMINE	-18.435	6.0239E-01	-4.4463E-04	1.6514E-07	-2.2558E-11	298	1200
319	C4H11NO2	DIETHANOLAMINE	-5.264	6.1929E-01	-4.9545E-04	2.1789E-07	-3.8987E-11	298	1500
320	C4H11NO2	2-AMINOETHOXYETHANOL	-5.199	6.2316E-01	-5.2386E-04	2.6796E-07	-6.4932E-11	298	1200
321	C4H12N2O	N-AMINOETHYL ETHANOLAMINE	-13.558	6.7312E-01	-5.4235E-04	2.4320E-07	-4.6505E-11	298	1500
322	C4H12Si	TETRAMETHYLSILANE	61.616	2.9614E-01	-1.0454E-05	-9.9222E-08	3.5679E-11	200	1500
323	C4H13N3	DIETHYLENE TRIAMINE	-8.147	6.7234E-01	-5.1124E-04	2.1737E-07	-4.0511E-11	298	1500

Appendix F

COMPOUND LIST BY FORMULA

CBrClF2	BROMOCHLORODIFLUOROMETHANE.....	1(Vol 1)	C2H2Cl2O	CHLOROACETYL CHLORIDE.....	71(Vol 1)
CBrCl3	BROMOTRICHLOROMETHANE.....	2(Vol 1)	C2H2Cl2O	DICHLOROACETALDEHYDE.....	72(Vol 1)
CBrF3	BROMOTRIFLUOROMETHANE.....	3(Vol 1)	C2H2Cl2O2	DICHLOROACETIC ACID.....	73(Vol 1)
CBr2F2	DIBROMODIFLUOROMETHANE.....	4(Vol 1)	C2H2Cl3F	1,1,1-TRICHLOROFLUOROETHANE.....	74(Vol 1)
CClF3	CHLOROTRIFLUOROMETHANE.....	5(Vol 1)	C2H2Cl4	1,1,1,2-TETRACHLOROETHANE.....	75(Vol 1)
CClN	CYANOGEN CHLORIDE.....	6(Vol 1)	C2H2Cl4	1,1,2,2-TETRACHLOROETHANE.....	76(Vol 1)
CCl2F2	DICHLORODIFLUOROMETHANE.....	7(Vol 1)	C2H2F2	1,1-DIFLUOROETHYLENE.....	77(Vol 1)
CCl2O	PHOSGENE.....	8(Vol 1)	C2H2F4	1,1,1,2-TETRAFLUOROETHANE.....	78(Vol 1)
CCl3F	TRICHLOROFLUOROMETHANE.....	9(Vol 1)	C2H2O	KETENE.....	79(Vol 1)
CCl4	CARBON TETRACHLORIDE.....	10(Vol 1)	C2H2O4	OXALIC ACID.....	80(Vol 1)
CF2O	CARBONYL FLUORIDE.....	11(Vol 1)	C2H3Br	VINYL BROMIDE.....	81(Vol 1)
CF4	CARBON TETRAFLUORIDE.....	12(Vol 1)	C2H3Cl	VINYL CHLORIDE.....	82(Vol 1)
CHBr3	TRIBROMOMETHANE.....	13(Vol 1)	C2H3ClF2	1-CHLORO-1,1-DIFLUOROETHANE.....	83(Vol 1)
CHClF2	CHLORODIFLUOROMETHANE.....	14(Vol 1)	C2H3ClO	ACETYL CHLORIDE.....	84(Vol 1)
CHCl2F	DICHLOROFLUOROMETHANE.....	15(Vol 1)	C2H3ClO	CHLOROACETALDEHYDE.....	85(Vol 1)
CHCl3	CHLOROFORM.....	16(Vol 1)	C2H3ClO2	CHLOROACETIC ACID.....	86(Vol 1)
CHF3	TRIFLUOROMETHANE.....	17(Vol 1)	C2H3ClO2	METHYL CHLOROFORMATE.....	87(Vol 1)
CHN	HYDROGEN CYANIDE.....	18(Vol 1)	C2H3Cl3	1,1,1-TRICHLOROETHANE.....	88(Vol 1)
CH2BrCl	BROMOCHLOROMETHANE.....	19(Vol 1)	C2H3Cl3	1,1,2-TRICHLOROETHANE.....	89(Vol 1)
CH2Br2	DIBROMOMETHANE.....	20(Vol 1)	C2H3F	VINYL FLUORIDE.....	90(Vol 1)
CH2Cl2	DICHLOROMETHANE.....	21(Vol 1)	C2H3F3	1,1,1-TRIFLUOROETHANE.....	91(Vol 1)
CH2F2	DIFLUOROMETHANE.....	22(Vol 1)	C2H3N	ACETONITRILE.....	92(Vol 1)
CH2I2	DIIODOMETHANE.....	23(Vol 1)	C2H3NO	METHYL ISOCYANATE.....	93(Vol 1)
CH2O	FORMALDEHYDE.....	24(Vol 1)	C2H4	ETHYLENE.....	94(Vol 1)
CH2O2	FORMIC ACID.....	25(Vol 1)	C2H4Br2	1,1-DIBROMOETHANE.....	95(Vol 1)
CH3Br	METHYL BROMIDE.....	26(Vol 1)	C2H4Br2	1,2-DIBROMOETHANE.....	96(Vol 1)
CH3Cl	METHYL CHLORIDE.....	27(Vol 1)	C2H4Cl2	1,1-DICHLOROETHANE.....	97(Vol 1)
CH3Cl3Si	METHYL TRICHLOROSILANE.....	28(Vol 1)	C2H4Cl2	1,2-DICHLOROETHANE.....	98(Vol 1)
CH3F	METHYL FLUORIDE.....	29(Vol 1)	C2H4Cl2O	BIS(CHLOROMETHYL)ETHER.....	99(Vol 1)
CH3I	METHYL IODIDE.....	30(Vol 1)	C2H4F2	1,1-DIFLUOROETHANE.....	100(Vol 1)
CH3NO	FORMAMIDE.....	31(Vol 1)	C2H4F2	1,2-DIFLUOROETHANE.....	101(Vol 1)
CH3NO2	NITROMETHANE.....	32(Vol 1)	C2H4O	ACETALDEHYDE.....	102(Vol 1)
CH4	METHANE.....	33(Vol 1)	C2H4O	ETHYLENE OXIDE.....	103(Vol 1)
CH4Cl2Si	METHYL DICHLOROSILANE.....	34(Vol 1)	C2H4O2	ACETIC ACID.....	104(Vol 1)
CH4O	METHANOL.....	35(Vol 1)	C2H4O2	METHYL FORMATE.....	105(Vol 1)
CH4O3S	METHANESULFONIC ACID.....	36(Vol 1)	C2H5Br	BROMOETHANE.....	106(Vol 1)
CH4S	METHYL MERCAPTAN.....	37(Vol 1)	C2H5Cl	ETHYL CHLORIDE.....	107(Vol 1)
CH5ClSi	METHYL CHLOROSILANE.....	38(Vol 1)	C2H5ClO	2-CHLOROETHANOL.....	108(Vol 1)
CH5N	METHYLAMINE.....	39(Vol 1)	C2H5F	ETHYL FLUORIDE.....	109(Vol 1)
CH6Si	METHYL SILANE.....	40(Vol 1)	C2H5I	ETHYL IODIDE.....	110(Vol 1)
CN4O8	TETRANITROMETHANE.....	41(Vol 1)	C2H5N	ETHYLENEIMINE.....	111(Vol 1)
CO	CARBON MONOXIDE.....	42(Vol 1)	C2H5NO	ACETAMIDE.....	112(Vol 1)
COS	CARBONYL SULFIDE.....	43(Vol 1)	C2H5NO	N-METHYLFORMAMIDE.....	113(Vol 1)
CO2	CARBON DIOXIDE.....	44(Vol 1)	C2H5NO2	NITROETHANE.....	114(Vol 1)
CS2	CARBON DISULFIDE.....	45(Vol 1)	C2H6	ETHANE.....	115(Vol 1)
C2BrF3	BROMOTRIFLUOROETHYLENE.....	46(Vol 1)	C2H6AlCl	DIMETHYLALUMINUM CHLORIDE.....	116(Vol 1)
C2Br2F4	1,2-DIBROMOTETRAFLUOROETHANE.....	47(Vol 1)	C2H6O	DIMETHYL ETHER.....	117(Vol 1)
C2ClF3	CHLOROTRIFLUOROETHYLENE.....	48(Vol 1)	C2H6O	ETHANOL.....	118(Vol 1)
C2ClF5	CHLOROPENTAFLUOROETHANE.....	49(Vol 1)	C2H6OS	DIMETHYL SULFOXIDE.....	119(Vol 1)
C2Cl2F4	1,2-DICHLOROTETRAFLUOROETHANE.....	50(Vol 1)	C2H6O2	ETHYLENE GLYCOL.....	120(Vol 1)
C2Cl3F3	1,1,2-TRICHLOROTRIFLUOROETHANE.....	51(Vol 1)	C2H6O4S	DIMETHYL SULFATE.....	121(Vol 1)
C2Cl4	TETRACHLOROETHYLENE.....	52(Vol 1)	C2H6S	DIMETHYL SULFIDE.....	122(Vol 1)
C2Cl4F2	1,1,2,2-TETRACHLORODIFLUOROETHANE.....	53(Vol 1)	C2H6S	ETHYL MERCAPTAN.....	123(Vol 1)
C2Cl4O	TRICHLOROACETYL CHLORIDE.....	54(Vol 1)	C2H6S2	DIMETHYL DISULFIDE.....	124(Vol 1)
C2Cl6	HEXACHLOROETHANE.....	55(Vol 1)	C2H7N	DIMETHYLAMINE.....	125(Vol 1)
C2F4	TETRAFLUOROETHYLENE.....	56(Vol 1)	C2H7N	ETHYLAMINE.....	126(Vol 1)
C2F6	HEXAFLUOROETHANE.....	57(Vol 1)	C2H7NO	MONOETHANOLAMINE.....	127(Vol 1)
C2HBrClF3	HALOTHANE.....	58(Vol 1)	C2H8N2	ETHYLENEDIAMINE.....	128(Vol 1)
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Appendix H

Computer Program for Thermodynamic Properties

A computer program for calculation of thermodynamic properties using the Peng-Robinson equation of state is available for a nominal fee (Carl L. Yaws, Box 10053, Lamar University, Beaumont, TX 77710, phone/FAX 409-880-8787). The computer program is executable and complete with data files. The program calculates thermodynamic properties at pressures and temperatures that are input by the user. Representative results are shown below:

COMPOUND: 38 CH4 METHANE

reference state: datum of ideal gas @ 77 F (25 C)

P psia	T F	Z	V ft ³ /lb	H BTU/lb	S BTU/lb F
-----	-----	-----	-----	-----	-----
500.0	-100.00	0.711	0.342	-129.42	-0.715
500.0	0.00	0.878	0.540	-63.12	-0.552
500.0	100.00	0.938	0.703	-3.09	-0.434
500.0	200.00	0.967	0.854	57.52	-0.334
500.0	300.00	0.983	1.000	120.68	-0.245
500.0	400.00	0.993	1.142	187.39	-0.163
500.0	500.00	0.998	1.282	258.21	-0.085
500.0	1000.00	1.008	1.968	680.95	0.267
3000.0	-100.00	0.588	0.047	-247.28	-1.144
3000.0	0.00	0.699	0.072	-151.24	-0.909
3000.0	100.00	0.837	0.105	-63.59	-0.736
3000.0	200.00	0.925	0.136	13.76	-0.608
3000.0	300.00	0.976	0.165	87.76	-0.504
3000.0	400.00	1.007	0.193	162.12	-0.412
3000.0	500.00	1.026	0.220	238.68	-0.328
3000.0	1000.00	1.053	0.343	677.10	0.037
10000.0	-100.00	1.537	0.037	-233.64	-1.252
10000.0	0.00	1.385	0.043	-159.84	-1.071
10000.0	100.00	1.317	0.049	-84.87	-0.924
10000.0	200.00	1.287	0.057	-9.10	-0.799
10000.0	300.00	1.272	0.065	67.70	-0.691
10000.0	400.00	1.262	0.073	146.20	-0.594
10000.0	500.00	1.254	0.081	227.12	-0.505
10000.0	1000.00	1.215	0.119	683.01	-0.125